BREAKTHROUGH! IN-FLIGHT ENGINE TESTING

MODEL AIRPLANE NEWS

48120 December 1992

THE WORLD'S PREMIER R/C MODELING MAGAZINE

FREE! PLANS DIRECTORY

SCALE SOUND

HOW TO'S
- Tail-Wheel Assembly
- Lighter Foam Wings
- Iron-On Panel Lines
- Choosing a Prop
- Fun-Fly Radio Mixing

REVIEWS
- Byron Ryan STA
- Great Planes Spiri
- Estes Astro Blaste

CONSTRUCTION: deHavilland HORNET

HOLIDAY WISH LIST

USA $2.95 CANADA $3.75

12

0 71896 48120 4

MODEL AIRPLANE NEWS

THE WORLD'S PREMIER R/C MODELING MAGAZINE

FREE PLANS DIRECTORY
(Starts after page 70)

FEATURES

ABOVE: *the Estes Astro Blaster heads for the sky with columnist David Baron at the sticks. Senior Editor Chris Chianelli holds the ignition button. Photo by Tom Atwood.*

ON THE COVER: *Forrest Edwards' scratch-built Polikarpov PO-2 sports a scratch-built, 5-cylinder, supercharged radial engine. The plane appeared at the recent 4-Stroke Scale Fly-In & Expo. Photo by Steve Dunham.*

FEATURES

HELICOPTER SECTION

CONSTRUCTION

COLUMNS

DEPARTMENTS

Model Airplane News (ISSN 0026-7295) is published monthly by **Air Age, Inc.**, 251 Danbury Rd., Wilton, CT 06897. Second-class postage paid at Wilton, CT, and at additional mailing offices. Subscription rates are: $27.95 for 1 year (foreign, $37.95); $49.95 for 2 years (foreign $69.95). **Postmaster:** send Form 3597 to **Model Airplane News**, P.O. Box 428, Mount Morris, IL 61054.

EDITORIAL

TOM ATWOOD

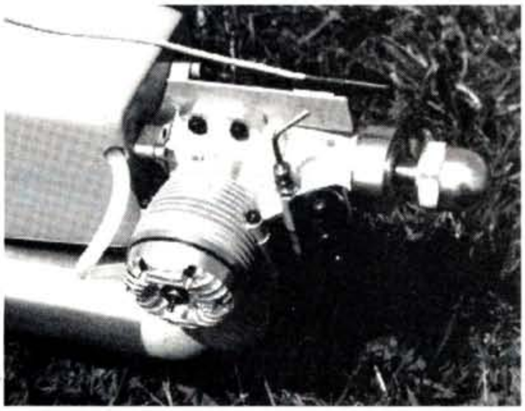
IN-FLIGHT ENGINE TESTING

We are delighted to introduce in this issue the first installment of "Real Performance Measurement," a new, and we think revolutionary, series of engine reviews by Dave Gierke. Dave evaluates engine performance both on the dynamometer and in the air. Propeller rpm and air speed are measured by onboard instrumentation and telemetered down to a receiver. On the ground, Dave tests the engines on a dynamometer that he designed and built himself. As you will see, Dave's approach provides fascinating new insights into engine performance.

Dave's credentials are many. Since the age of seven, he has been involved with model aviation, and for the past 43 years, he has been designing, constructing and competing with his models on a national level. Early in his career, Dave spent summers working with Hal "Pappy" deBolt, manufacturing model airplane kits.

Dave has varied interests within the hobby. From his teens through his twenties, he competed in control-line events. Later, he became interested in R/C and pursued pylon racing. Today, in addition to a broad involvement in R/C sport flying, Dave is working on models involving compressed air, rubber power, electric and spark ignition. Over the years, Dave has developed many of his own airplane designs. His *NOVI* is a classic control-line design which has recently become eligible to fly in the "Nostalgia Stunt" event.

Dave Gierke uses his dynamometer to extract technical data during an engine test.



Onboard sensors gather in-flight engine data that is telemetered to a receiver on the ground. Note the rpm sensor.

Long-time modelers will find Dave's a familiar name in the hobby. He has published over 20 articles since 1967. These have treated such topics as model design, engine testing, atmospheric effects on performance, analysis of two-stroke oils, and finishing techniques (several of which have won him top awards at the Toledo R/C shows). Dave received his masters in 1971 from the State University College at Buffalo (NY). Since 1963, he has been a teacher of Technology (Industrial Arts) at the high school level. In 1978, Dave was named Teacher of the Year for New York State.

Because of his interest in the hobby, Dave's students are regularly introduced to problem-solving scenarios that involve the use of modeling skills. As an example, Aerospace and Transportation courses he has developed require students to construct indoor, rubber-powered models, which are then tested through competition between his classes. Model rockets are also used—in fact, while other students are studying for exams in late May and June, Dave's students are out in the sunshine test-flying their model rockets!

Dave was the "engine man" for his father's racing hydroplanes and was briefly involved in drag racing. You can see Dave has had some varied experiences with one common thread; he likes to know what makes things work, and he likes to "go fast." As a teacher, Dave is also a very effective communicator. For starters, see Dave's review of the Nelson Q40 this issue.

USA TEAMS PLACE HIGH IN FAI CONTESTS

We would like to congratulate the U.S. teams who performed so well in the recent FAI contests. In the FAI World Scale Championships held in Muncie, IN, on August 21 to 29, the U.S. team took 2nd in F4C. The United Kingdom took first and Germany third. In the F3E Electroflight World Championships, held in Arnem, Netherlands, on August 19 to 22, The US team captured the gold medal by an impressive margin. They finished 201 points ahead of second-place winner, Austria, and 480 points ahead of third-place Germany. More on this in future issues!

AEROBATICS COLUMN

Dave Patrick, author of "Aerobatics Made Easy," has noted he will be taking a break for a few months from writing his popular column. In addition to wielding the responsibilities of VP of Marketing and chief model designer at Carl Goldberg Models, Dave has had to make time to train for the Madera Unlimited Races (September 23 to 27), and the Tournament of Champions (October 22 to 25). As we go to press, Dave is also working on the third tape in the much-applauded "Wring it Out" video series. We understand the formidable time demands he faces and look forward to his return to these pages early next year. In the meantime, selected guest columnists will appear (see U.S. National Pattern Champion David von Linsowe's guest column, this issue). ■

MODEL AIRPLANE NEWS
THE WORLD'S PREMIER R/C MODELING MAGAZINE

Group Publisher	LOUIS V. DeFRANCESCO JR.
Publisher	DR. LOUIS V. DeFRANCESCO
Associate Publisher	YVONNE M. DeFRANCESCO
Editor-in-Chief	TOM ATWOOD
Senior Editor	CHRIS CHIANELLI
Associate Editor	GERRY YARRISH
Editorial Assistant	JULIE SORIANO
Copy Director	LYNNE SEWELL
Copy Editors	KATHERINE TOLLIVER DEBORAH S. CARROLL KAREN JEFFCOAT DIANA L. WINARSKI
Corporate Art Director	ALAN J. PALERMO
Associate Art Director	MARY LOU RAMOS
Assistant Art Directors	BETTY K. NERO MATTHEW J. LONGLEY
Art Assistant	STEPHANIE L. WARZECHA ALLYSON NICKOWITZ
Promotional Artist	ROBIN DEMOUGEOT
Staff Photographers	WALTER SIDAS LISA KNORRA
Systems Manager	EDWARD P. SCHENK
Systems Coordinator	JEFF WASILKO
Director of Marketing	GARY DOLZALL
Circulation Manager	KATHLEEN RHODES
Marketing Manager	PAULINE A. GERRY
Circulation Assistant	KYRA DUHAIME
Production Manager	MARY REID McELWEE
Advertising Account Representative (East)	KURT G. SWENSON
Advertising Account Representative (Midwest)	MICHAEL S. STANKIEWICZ
Advertising Account Representative (West)	SHARON WARNER
Advertising Traffic Coordinator	ELISE SILKOWSKI

SUBSCRIPTION PRICES: U.S. & Possessions (including APO & FPO): 1 year (12 issues), $27.95; 2 years (24 issues), $49.95. Outside U.S.: 1 year, $37.95; 2 years, $69.95. Payment must be in U.S. funds.

SUBSCRIPTION INQUIRIES: call 1-800-827-0323.

MODEL AIRPLANE NEWS (ISSN No. 0026-7295) is published monthly by Air Age, Inc., 251 Danbury Rd., Wilton, CT 06897. Connecticut. Editorial and Business Offices, 251 Danbury Rd., Wilton, CT 06897. Phone: 203-834-2900. FAX: 203-762-9803. Y.P. Johnson, President; G.E. DeFrancesco, Vice President; L.V. DeFrancesco, Secretary; Yvonne M. DeFrancesco, Treasurer. Second Class Postage Permit paid at Wilton, Connecticut, and additional Mailing Offices.

CONTRIBUTIONS: To authors, photographers, and people featured in this magazine, all materials published in *Model Airplane News* become the exclusive property of Air Age, Inc., unless prior arrangement is made in writing with the Publisher. The Publisher assumes no responsibility for unsolicited material. Only manuscripts and supporting material accompanied by an SASE will be returned.

ADVERTISING: Advertising rates available on request. Please send advertising materials, insertion orders, etc., to *Model Airplane News*, Advertising Dept., Air Age, Inc., 251 Danbury Rd., Wilton, CT 06897. Phone: (203) 834-2900. FAX: (203) 762-9803.

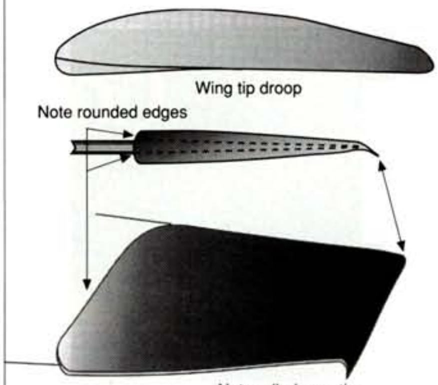
CHANGE OF ADDRESS: To make sure you don't miss any issues, send your new address to *Model Airplane News*, Subscription Dept., P.O. Box 428, Mount Morris, IL 61054, six weeks before you move. Please include the address label from a recent issue, or print the information exactly as shown on the label. The Post Office will not forward copies unless you provide extra postage. Duplicate issues cannot be sent.

POSTMASTER: Please send Form 3579 to *Model Airplane News*, P.O. Box 428, Mount Morris, IL 61054

ABC MEMBERSHIP APPLIED FOR

AIRWAVES

WRITE TO US! We welcome your comments and suggestions. Letters should be addressed to "Airwaves," **Model Airplane News,** 251 Danbury Road, Wilton, CT 06897. Letters may be edited for clarity and brevity. We regret that, owing to the tremendous numbers of letters we receive, we cannot respond to every one.



Detail from Roy Clough Jr.s design

MORE ON STALLS

I read with interest Mr. Clough's letter in your July issue regarding the enlarged wing tip. I did see a similar test in "Aviation and Space Week" several years ago, but this idea began way before that.

In 1949, Alexander Kartveli of Republic Aircraft designed the XF-91 that worked on this same principle. The wing tip was much wider and thicker in profile than the root to improve the performance of the swept wing while retaining the benefits. The difference in thickness was so great that the main landing gear had to retract toward the tip where the wheels were stored during flight. The XF-91 was very successful, but this type of design is not often practical or necessary.

Mr. Clough's design includes a hidden point that's very important. The wing area has been increased, as has the wingspan. Because of this, we have a net increase in lift and a better lift-to-drag ratio. This added span has also increased the aspect ratio from 10.32 to 12.17—a very sizeable gain, and surely a much more efficient wing to boot.

These aspects alone contribute to the slower stall speed, better climb, better slow flight and longer flight time. Now to the good stuff.

The [reduced tendency to] tip-stall is directly connected to the new tip design. The thicker-section profile stalls later (higher angle of attack), mainly owing to its better characteristics. From the drawings, I also reached some conclusions about the design. The Hoerner tips are virtually useless because they don't appear to be large enough. Also, by rounding them, you promote vortex flow, and thus are less efficient. The joint between the thick and thin wing sections acts as a wing fence and should be left square to be most efficient. The leading edge of the new section also protrudes in front of the original leading edge, creating a "dog tooth" and thus providing some vortex control over the outer section airflow that helps at high angles of attack.

This particular wing is straight, thus, there is no span-wise flow except at the very tip. This leaves nothing to improve and no reason to round the thick/thin joint.

The reason for this tip design is exactly what Mr. Clough used it for here—safety and more efficiency. In many cases they aren't practical because they upset the elliptical lift distribution of the wing and cause too much loading on the outer section. This results in a wing that's harder to make strong enough to handle these loads in extreme conditions.

If an experiment were to be conducted in this area, the area of the wing tips would have to be subtracted from the original wing so that the new design didn't have a gain in wing area or span. I hope that this answers any questions, and I'm sorry about the technical talk, but some things you can't simplify.

DENNIS RASTETTER
Designer, Glennis Aircraft
Linda, CA

Dennis, please no apologies! Our readers will appreciate the insights. Many of our readers are hungry for this type of information exchange in this column, and we encourage it. TA

STILL MORE ON STALLS

A few issues back, a gentleman asked about drooping tips on models ("Airwaves," July '92). I may be able to give some insight on their use and operation. I've built home-built aircraft using these tips.

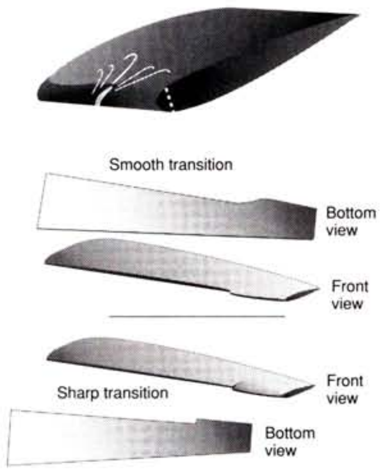
Questair, a company in Greensboro, NC, builds an aircraft called the "Venture," and its sister, the "Spirit." Both these aircraft use the droop tips and another little-known device called the "Rao slot." NASA and North Carolina State University jointly tested the droop tips. Briefly, these were their findings:

Adding droop tips to a constant-chord, flat-to-semisymmetrical wing improved the stall and slow-speed characteristics.

The tips eased the stall and gave better aileron control deeper into the stall. They tested the tips using a sharp discontinuity at the tip-wing juncture and also with a fairing to smooth the transition.

They found that the wing with the sharp discontinuity had better stall characteristics and also recovered from both standard and flat spins better. Their reasoning for this is that, as the wing stalls, the tip, being a longer chorded airfoil, stalls after the rest of the inboard wing, with similar results to wing washout. But they also noticed that the tip kept flying even deeper in the stall. A vortex is made at the tip and wing discontinuity and allows airflow to pass over that section of the tip deep in the stall; it, therefore also reduces tip stalls and resultant unintentional spins. The wing with the smooth transition from wing to tip behaved as any other wing after the tip was stalled.

RAO SLOT



The Rao slot is a vertical slot cut about 1 inch deep by $^{1}/_{4}$ inch wide into the wing's leading edge (see sketch). Questair uses two—one about mid-span and another at the droop tip-wing juncture. Again, this device is to improve stall and spin characteristics. The Rao slot is supposed to allow higher-pressure air on the bottom of the wing to "leak" onto the upper surface causing a vortex and re-attaching the airflow in a stall. In normal flight, the slot is filled with stagnant air and is more or less inert.

By using both of these devices, Questair has significantly increased the performance of the Venture wing,

(Continued on page 10)

AIRWAVES

reduced its complexity (by not using retractable slats) and saved considerable weight. Use on our models with foam wings would certainly be simple. Add a tip and saw a few slots, and you'll have a much better-mannered wing.

DAVID E. YARBROUGH
Kernersville, NC

PROP-ER DECALS

I'm building a 1/4-scale model of a Piper J-3 Cub (Sig kit). This is my first giant-scale model and my first attempt at serious detailing. I painted the model with K&B epoxy paint over Sig Coverall and, except for the Piper logo, I painted all the markings by hand.

My question is: where can I get manu-facturer's prop decals? The aircraft I'm modeling uses a Sensenich wooden propeller. I hand-carved a "static" prop, complete with leading-edge metal capping. But I'm not good enough to hand-paint the prop decal.

Your mag is great!

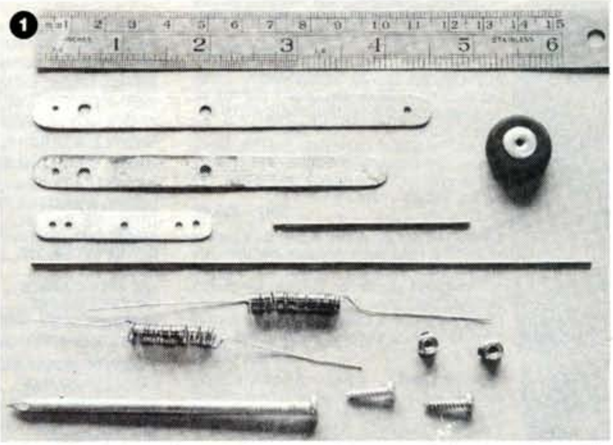
KEITH BURDER
New London, CT

Keith, good news in the prop-decal department. We called the folks at Northeastern Screen Graphics and found out that they have just added a bunch of new water-slide and Mylar stick-on decals to their Major Decals inventory. New propeller decals include Axial, Dowty Rotol and Sensenich. They're available in 1/8, 1/6, 1/5, and 1/4 scale. They also have Falcon, McCauley, Hamilton Standard, Fahlin, Hartzell and Pratt & Whitney prop decals. All decals are printed in the manufacturer's colors and would be the finishing touch for any scale model propeller.

Contact Northeastern Screen Graphics at P.O. Box 304, East Longmeadow, MA 01028; (413) 525-4110. The Sensenich decal number is P-14. You get 12 decals (four of each in three sizes), and it's $7.50 a sheet. Ask for Kathy, and say Model Airplane News sent you. GY

Make a
BUDGET ★ FLIER
Tail-Wheel Assembly

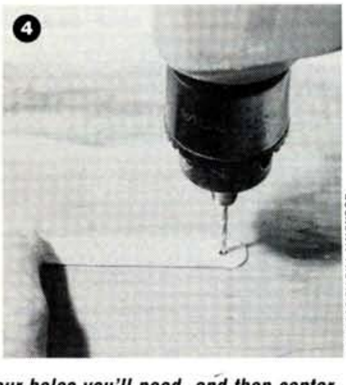
by BILL HAYWOOD



1. You'll need: a piece of 20-gauge sheet metal that's at least $4\frac{1}{2}$ inches long and 2 inches wide (you'll use it to make two, 20-gauge leaf springs and one 20-gauge tiller arm); a suitable tail wheel; $\frac{1}{16}$-inch music wire; $\frac{1}{64}$-inch music wire (for tiller springs); a 3-inch nail; two mounting screws; two $\frac{1}{16}$-inch wheel collars.

OFTEN, A MODELER will spend huge chunks of his spare time on building and finishing a beautiful aircraft. He will fit it with a good prop, scale wheels, a sturdy main landing gear and even wheel pants. But when he visits the local hobby shop in search of a scale, or scale-like, tail-wheel assembly, his real difficulties begin. Good, inexpensive tail-wheel assemblies of the correct size are very difficult to find, and he must usually either build one himself or screw a humdrum, awful-looking, plastic assembly onto the back of his model. No more! Build one of these state-of-the-art, tail-wheel assemblies for your next model—and all the others.

2. Cut two, $\frac{3}{8}$-inch-wide strips out of the sheet metal; one strip should be $4\frac{1}{2}$ inches long and the other, 4 inches long. Use the strips to make two leaf springs.



PHOTOS BY BILL HAYWOOD

3. Mark the positions of the four holes you'll need, and then center-punch them (see illustration). Drill two $\frac{1}{8}$-inch holes (for the mounting screws) and two $\frac{1}{16}$-inch holes—one for the tail-wheel axle and one to secure the central music-wire spring. 4. Put the sheet-metal strips (leaf springs) over a piece of wood, and then drill the holes. Make sure they're centered along the strips' length.

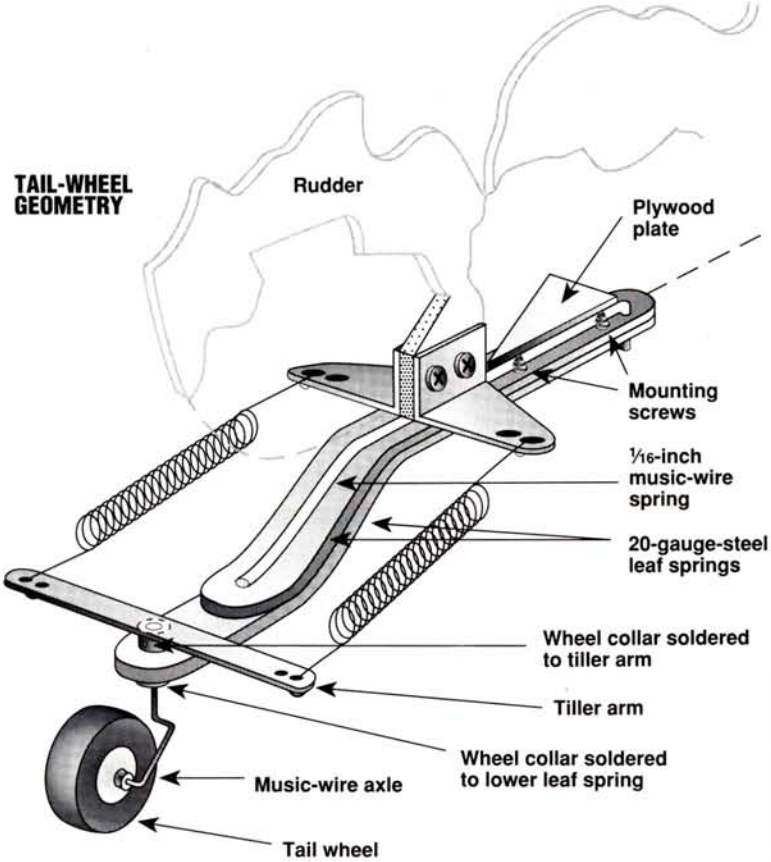
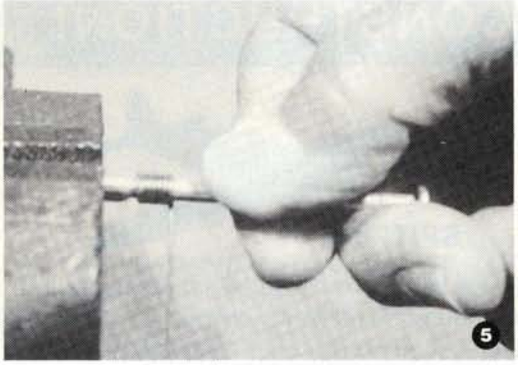
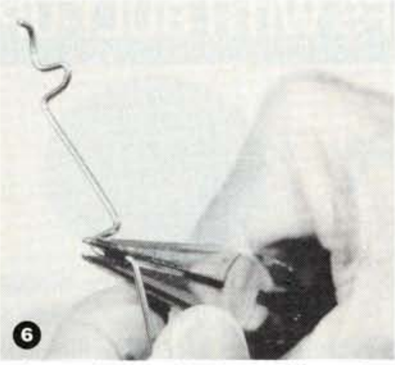
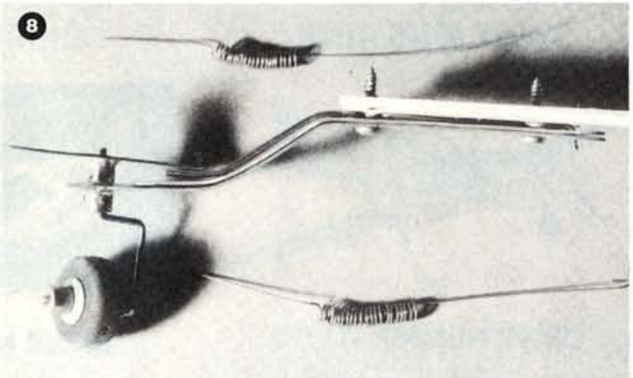


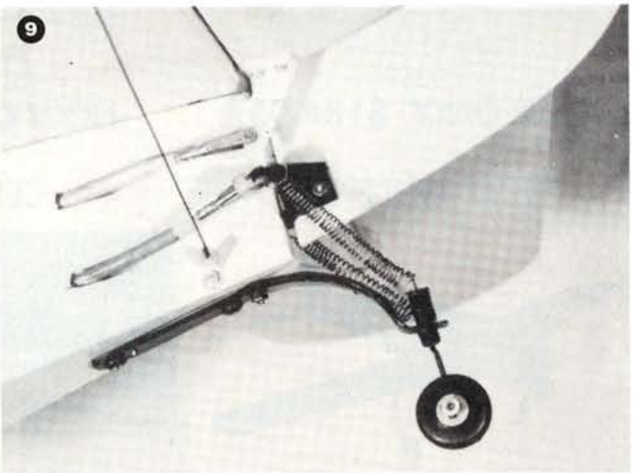
ILLUSTRATION BY STEVE KARP





5.Hold one end of the 1/64-inch music wire and the nail in a vice, as shown, and make two tiller springs by tightly coiling the wire around the nail for about 1 inch. (To do this, you must first capture the music wire between the nail and the vice jaw.) 6.Bend the music-wire spring you just made as shown. The two bends will allow the spring to be held in place by the mounting screws.





7. Here, the spring is held by the two mounting screws. 8.The finished tail-wheel assembly. Note how the music-wire spring protrudes through the front ends of the leaf springs. 9. A version of the completed tail-wheel assembly on a smaller plane.

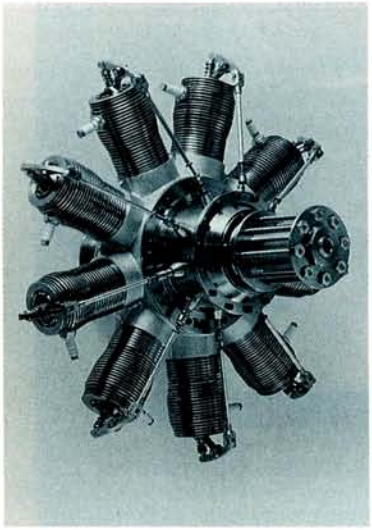
The tail-wheel assembly described here is sturdy, good-looking and very easy to build. It takes very little time to make it, and you'll need only simple tools and materials that are probably already at hand. It can be built in almost any size, and another outstanding feature is its low cost.

Tail-wheel leaf springs are usually made out of spring steel, which is expensive, brittle, hard and difficult to work with; and most of us don't have the right tools or facilities to work with it. This tail-wheel assembly is made out of ordinary, 20-gauge, galvanized sheet metal, which can be cut and bent easily. This mild steel can be used only because 1/16-inch music wire is integral to the assembly. The wire is strong enough to support the model on the ground and flexible enough to cushion it when it lands. Don't leave out this most important component! The music wire is the secret to the success of this light, rugged, tail-wheel assembly! ■

AIR SCOOP

CHRIS CHIANELLI

New products or people behind the scenes—my sources have been put on alert to get the scoop! In this column, you'll find new things that will, at times, cause consternation, and telepathic insults will probably be launched in my general direction! But who cares?—it's you, the reader, who matters most! I spy for those who fly!

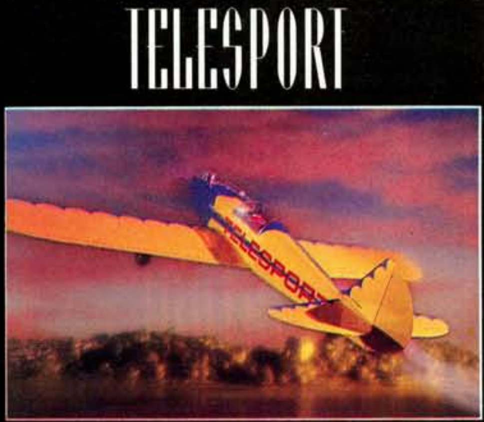


¼-Scale Gnome Rotary

This museum-quality, ¼-scale, operating Gnome Rotary engine—yes, the entire engine spins around the crankshaft—is the result of several years' effort and is the first in a series of operational scale engines that are modeled after internal-combustion powerplants. Though a few parts, i.e., plugs and rocker-arms, aren't scale on the prototype in this photo, they will be on the 100-percent-scale production versions. The 9-inch-diameter, ¼-scale Gnome has a displacement of 3.97ci, and its full-scale features include crankchamber induction via the hollow crankshaft and planetary timing gears.

For more information, contact Replica Engines, 16640 S. 104 Ave., Orland Park, IL 60462; (708) 403-5127; fax: (708) 403-5625.

TELESPORT



Hobby Lobby says its new Telesport is the perfect plane with which to make the transition from a high-wing trainer, like the Telemaster, to low-wing sport flier. This all-balsa kit features a fully symmetrical tapered wing; accurately die-cut, high-quality balsa; and full hardware pack. Construction time is relatively short.

SPECIFICATIONS
wingspan—60-inches
length—45 inches
wing area—635 square inches
flying weight—6 pounds
.40-, .50-, or .60-size 2-stroke engines are recommended.
Price: $88.50.

Enforcer APU-30

Warehouse Hobbies, well known and respected for its Enforcer line of ignition-powered racing boats, has introduced the APU-30—an American-made, 30cc gas engine that features a high-performance carburetor, a firewall mount, a muffler, a resistor spark plug and a one-year Enforcer warranty (not a crash warranty). The APU-30 will handle aircraft up to 15 pounds. Suggested list price—$229.95; introductory price—$189.

BLACKHAWK DEALS WITH THE ENEMY

Modeler enemy number one is, of course, engine vibration. The Blackhawk Edition line of ignition engines comes in nine sizes that range in displacement from 2.1 to 7.4cid, and all feature a rotating mass that's balanced to within a single gram. This reduces operating vibration which, at times, can be excessive with larger ignition engines. Other features include diamond-hard, silicon, carbide-impregnated chrome sleeves, Lubrizing™ cylinders, a magnesium crankcase, a magnesium cylinder jug and roller bearings on the conrod low end. The manufacturer claims the Blackhawk Edition will outlast the competition two to one! Order the parts directly from the factory (next-day shipping available on all parts).

For more information, contact A.B. Bowens at Midwest Aerospace Technologies, RR1, P.O. Box 107, Baring, MO 63531-9609; (816) 883-5780.

AIR SCOOP

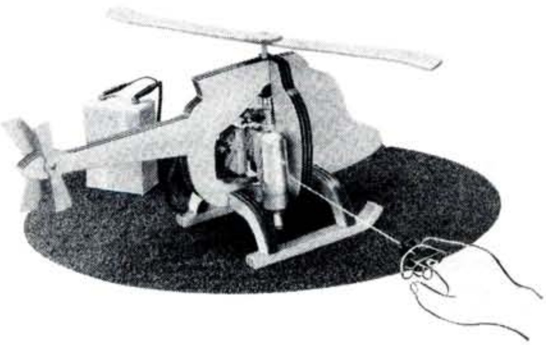
SAITO FA-150S

For over 20 years, Saito—a company that manufactures 4-stroke engines exclusively—has consistently refined its line. The most recent .50, .65, .80 and 1.20 engines are shining examples of this refinement. They're reliable, powerful and easy to operate. I've had very good experiences with these displacements. Now, Saito has released what is, to the best of my knowledge, the largest, single-cylinder 4-stroke engine commercially available. The FA-150S claims 2.5hp, and it will fly many giant-scale models swinging 14- to 18-inch props in the 2,200 to 10,000rpm range. The 150S features an AAC piston/cylinder combination (aluminum piston running in a hard-chromed aluminum sleeve).

SPECIFICATIONS
displacement—1.5ci;
weight—30.5 ounces;
bore—34mm;
stroke—27.6mm;
prop sizes range from 14x10 to18x4.

G&P MUSTANG

Bill Price, designer and owner of G&P Sales, has taken the fiberglass experience that he gained from designing and manufacturing the PBY, Albatross and Canadair flying boats and applied it to the classic curves of the P-51 Mustang. This 62-inch-span model is available in either D or B models. According to Bill, the thick wing section gives the model soft stall characteristics and makes it a great sport/fun airplane that has the added feature of a precision-scale outline. The 7½-pound P-51 is designed for .46 to .60 2-stroke engines, and it has a wing area of about 600 square inches. Bill says that the kit's features—a fiberglass fuselage, a prefabricated small-bead foam wing, stab and rudder cores—make the building process go quickly. The retract wells and the retract mounting-plate recess are factory-cut into the wing panels. The kit includes a full hardware set, a retractable tail wheel, a P-51-style spinner, full-size plans, vacu-formed ABS wheel-well liners, a canopy and an instrument panel. For more information, contact G&P Sales, 410 College Ave., Angwin, CA 94508; (707) 965-3866.



ADD SOME PULL

Ever contemplate how nice it would be not to have to lug that heavy 12V battery and starter unit to the field? Then you contemplate the cost of a new pull-start engine and quickly convince yourself that part of this hobby's fun actually is hauling as much garbage to the field as you can. The real fun starts around 11:30 p.m. when you're back at the field armed with a flashlight searching for that battery and starter you forgot—along with the sunglasses, the needle-nose pliers and the Tupperware your wife sealed your peanut-butter-and-jelly sandwich in—right? NOT! Well, if you're the owner of an O.S. 10FP, CZ-11, 21SE, or 32F-H, you can leave the starter and battery in the garage. O.S. now makes pull-start conversion kits for these engines, so you don't have to purchase the whole

dadgum thing. There is, however, no word on availability here in the States just yet, so don't go running for the phone, but the kits do exist and, hopefully, they'll be here soon! (In the meantime, keep that battery charged.)

PILOT PROJECTS

A LOOK AT WHAT OUR READERS ARE DOING

SEND IN YOUR SNAPSHOTS

Model Airplane News is your magazine and, as always, we encourage reader participation. In "Pilot Projects," we feature pictures from you—our readers. Both color slides and color prints are acceptable.

All photos used in this section will be eligible for a grand prize of $500, to be awarded at the end of 1992. The winner will be chosen from all entries published, so get a photo or two, plus a brief description, and send them in!

Send those pictures to: Pilot Projects, Model Airplane News, 251 Danbury Rd., Wilton, CT 06897.

ELECTRIC ANNIVERSARY

The lightning bolt on the side of this Cub, which belongs to Randy Smithhisler of Puyallup, WA, seems appropriate: the model was converted to electric power. Randy powers his Goldberg Anniversary-Edition Cub with an Astro Flight geared 25 Cobalt motor powered by 14 Panasonic SCR 1700mAh cells. To save weight, he removed the ailerons, and to make the plane easier to fly, he uses three channels. The 76½-inch-wingspan model weighs 7 pounds, 1 ounce, and it has a 13x8 Rev-Up prop. Using a Flightec SEC-II speed controller, the MonoKote-covered Cub flies in a very scale-like manner. This was Randy's first attempt at converting a glow model into electric, and it's great.

HUGE HORTEN

Built by Ken Jack of McGraths, Australia, this beautiful model of the Horten 229 V-3 German flying wing is powered by two O.S. .91 ducted-fan engines driving Ramtee fan units. The model has a 108-inch wingspan and is 49 inches long. The model has scale, retractable landing gear and an operating drag chute. Ken's 13-year-old daughter Zofia holds the model, so we can appreciate its size.

BABY ULTIMATE IS AN ACE

Owing to the popularity of the Ultimate Bipe in all its model configurations, David Fritzke of Minneapolis, MN, kit-bashed an Ace All Star Bipe kit to come up with this undersize "Ultimite." Powered by a Super Tigre .23, the model should be a real sizzler in the flight department. The wings are Ace constant-chord foam wings, the functional interplane struts are held in place with heavy-duty dress snaps and the cabanes are made of bicycle spokes.

FINNISH SMITH

Built from a Sig kit, this Smith Miniplane bipe is the work of Lauri Aaltio of Suomi, Finland. He submitted it because he noticed that we've never published a photo of a Finnish modeler's work. He's 15 years old, has four years of R/C experience and is a member of the Kivenlahti model airplane club. The Smith is covered with Solartex, painted with Miranol paint and powered by an O.S. .46 SF engine. It has a 44-inch wingspan and weighs 5.5 pounds. Lauri says that the Smith took six months to build and that it flies really well.

FANTASTIC FAN TRAINER

After building a Hobby Dynamics RFB-600 Fantrainer, Louis Hutton of Bellevue, WA, discovered the article on the $^{1}/_{2}$A Fantrainer in our January 1990 issue. This was his first scratch-building project in 50 years, and as any good modeler would, he added a few touches of his own: landing gear and a clear canopy with cockpit details to improve its scale appearance. He also replaced the .049 engine with the more powerful Cox Medallion .09 mill to help performance. The finished model weighs only 9 ounces more than the stock version, and that should make it a real performer. Nice job, Lou!

STINSON AIR AMBULANCE

John Julian of Ridge, NY, scratch-built this 18-pound, $^{1}/_{4}$-scale model of the Stinson L-5 Sentinel and outfitted it as an air-evac aircraft, complete with a stretcher and a wounded airman. Built from Vailly Aviation plans, the 72-inch-long model is powered by a Zenoah G-38 and has a 102-inch wingspan. The Stinson is covered with Supershrink Coverite and painted with silver dope and latex exterior paint. Its details include radios, an instrument panel, a checklist, fire extinguishers, a first-aid kit, throttle and flap handles and functional interior lighting. The pilot has a headset, sunglasses, dog tags, a shoulder harness containing a .38 revolver and a knee-board-mounted map. As you can see in the photo, the passenger's wounds are graphically detailed, too!

SEA-GOING EXTRA 300

This Extra 300 built by Glenn Watters of Wichita, KS, may not look unusual, but where it was built certainly *is.* Glenn is the wheelsman aboard the Paul H. Townsend (a cement carrier) and has been a Great Lakes Merchant Marine for 22 years. Each season, Glen builds a model while aboard ship, and when he reaches shore, he spends his time flying. This Goldberg Extra 300 is his latest seaborne creation, and he plans to test it on his next vacation. Maybe a floatplane version would allow some offshore flying.

PIZZA HOG

Judging from the photo he submitted of his modified Sig Astro Hog, Joe Zenchuk, of Omaha, NE, must love pizza and planes. Powered by a YS .61 engine turning a three-blade 12x8 prop, and controlled by a Futaba Super Seven, the model has a Sig Cavalier canopy and a new Extra 300 shaped, vertical tail. The finish is MonoKote with "Little Caesars" graphics cut by a custom sign shop. Joe didn't say how well the model flies, but we bet that with pepperoni and extra cheese, it delivers!

HOW TO

Editor's note: this is the second in a series by Faye Stilley, eight-time award winner at Toledo (including first place, MonoKote 1990 and 1991), and six-time award winner at the WRAM show. It is excerpted from a new Air Age title, "Covering R/C Airplanes," which is described in the Book Mart at the back of this magazine.

1. This MiG's appearance was greatly improved by the addition of panel lines. (It took third place in both Sport Monoplane and Monokote at the '91 Toledo show.)

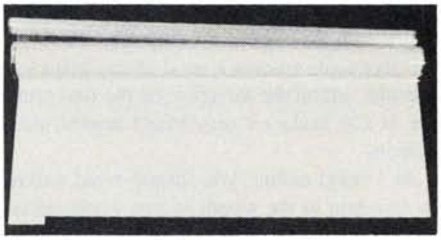
FOR ADDED SCALE REALISM

Make Panel Lines with Iron-On Film

by FAYE STILLEY

YOU CAN really enhance the scale appearance of your airplanes with panel lines. Unlike those made with striping tape, panel lines made with iron-on film (see Photo 1) won't be ruined by fuel or by being wiped down with a towel. Another big advantage of using iron-on film is the variety of colors that it comes in.

On a full-size red airplane, the panel lines look dark red, not black; on an aluminum airplane, they look dark silver; on a white or black aircraft, they look light or dark gray, and so on. For a scale appearance, make your panel lines using colors that are a variation of the background color, rather than black. (Refer to the Color Chart.) Also, be sure to switch to a film of the appropriate color whenever a panel line passes through insignias or other sections that have been covered in different colors. (See Photo 2.)



3. Using a straightedge or a T-square as a guide, cut the edge of the film so that it's perfectly straight and true.

Panel lines are easy to make, and it's fun to show them off at the field or at a contest. There aren't any tricks; just a couple of techniques that will enable you to cut those little, skinny strips out of film accurately.

TOOLS AND TECHNIQUES

For tools, you need only your trusty old modeling knife and a lot of no. 11 blades, a metal straightedge (or, better yet, a metal T-square), a ruler marked with 1/64-inch increments and a flat, smooth cutting surface (glass is best).

Remove the backing from the film, and place the film on the glass. Rub it with a soft cloth (preferably cotton) to remove all the wrinkles and to make it stick. If it doesn't stick tightly, remove it and moisten the glass with glass cleaner. Then, rub it again to remove wrinkles and bubbles.

Once the film is in place, you must ensure that its lower edge is straight so that the cut lines on your first strip will be true. Using your T-square or straightedge as a guide, cut off the lower edge. Be sure to stop just short of one side to create the "tab" as shown in Photo 3. (This tab will be useful later.)

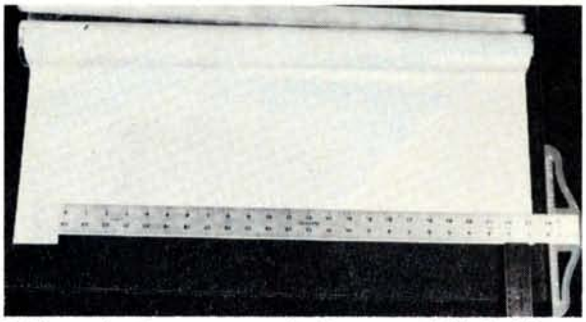
Lay your T-square or straightedge on the film, and position your ruler at a right angle to it as shown in Photo 4. Cut a 3/64-inch-wide strip, and then continue to move the T-square/straightedge up from the bottom by 3/64 inch after each successive cut. (Note: if you make the panel lines any thicker, your model may look like an ARF.) Cut the strips only to the tab that you

2. To ensure that your panel lines will be realistic, switch the lines to a film of the appropriate color whenever the color of the background changes, i.e., in insignias, etc.

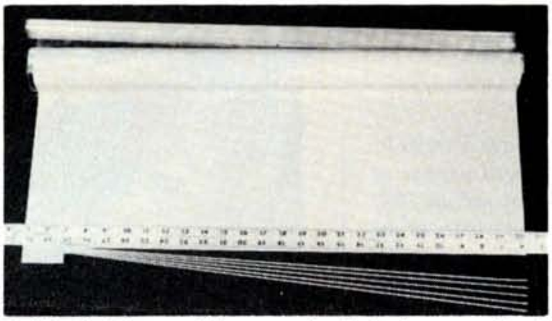
COLOR CHART

Black panel lines are rarely recommended because they don't look realistic. The colors you use should depend on the background film. Here are some suggestions using MonoKote shades:

Background Color	Panel-Line Color
White	Dove Gray
Black	Dove Gray, Metallic Charcoal, Platinum
Aluminum	Platinum, Metallic Charcoal
Red	Dark Red
Dark Red	Maroon, Red
Dark Blue	Medium Blue, Light Blue
Medium Blue	Dark Blue
Light Blue	Medium Blue
Yellow	Cub Yellow, Dove Gray
Orange	Cub Yellow, Tan, Yellow
Olive	Metallic Charcoal
Platinum	Metallic Charcoal, Aluminum
Metallic Charcoal	Black, Platinum
Most other metallics	Platinum



4. *After each cut, you can move the T-square up in 3/64-inch increments with a ruler, measuring as you go.*



5. *Note that the panel lines remain attached on one side of the cut.*

created earlier; this will enable you to keep them together until you're ready to use them. Then, you can cut and apply them one at a time so you'll always know which side has the adhesive. (See Photo 5.)

If you use a metal T-square, you only have to measure one side (the right side in the photos) of the film before you cut the strip. The "T" will ensure that the measurement is true from one side of the cut to the other. Each cut will be straight unless the film is moved.

Although it requires a little more time, you can achieve the same results using an ordinary metal straightedge. Press down on it to prevent it from moving while you measure first one side of the film and then the other. Go back and check that these measurements are accurate. You'll probably have to do this more than once, because it's easy to skew the measurement whenever you move the straightedge into position on either side. Do your best to make each strip exactly the same width so that, later, you'll be able to join two of them to create long panel lines.

"Follow these steps carefully, and your colleagues at the flying field will wonder how you managed to achieve such a high-quality trim job"

ATTACHING THE PANEL LINES

Attaching panel lines to a covered model is much easier than you might think. Because iron-on film can be stretched without heat, you can stretch the strips that you made into straight lines across the surface of the model.

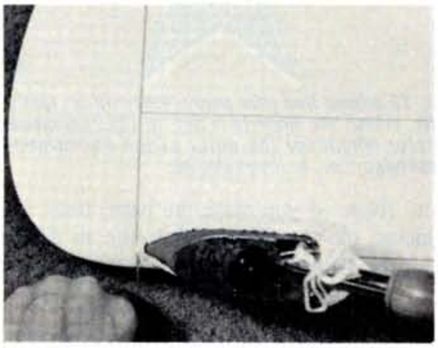
First, tack one end of the strip into place with a hot iron (for MonoKote, more than 300 degrees Fahrenheit). Then gently pull the other end until the strip is stretched flat across the surface. Hold the strip taut while you tack down the other end. (See Photo 6.)

Don't run the iron along the strip yet; this will stretch the film and create excess on one end, wrinkles, or a wavy line. Instead, tack the center of the strip (as shown in Photo 7), and then halfway between the center and each end. Continue to tack at the halfway points between previous tacks until the strip is fastened into place. Then, gently run the iron from one end to the other. Let the heat do the work; don't use pressure.

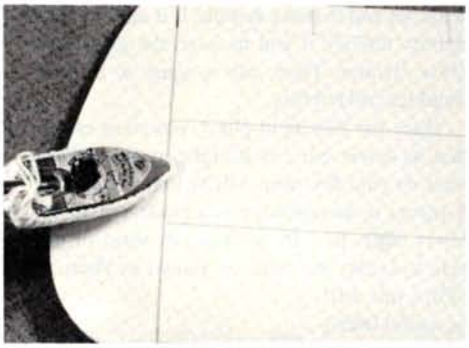
Sometimes, a panel line will intersect one that you applied earlier. When this happens, you'll have to cut the "second" strip so that it overlaps and forms a "T" with the one you first applied. (Do the cutting after both lines have been tacked into place.) At the intersection, lift the second strip off the first, slide a thin piece of clear plastic under it, and cut it so that it's square with the edge of the first. (See Photo 8.) This technique ensures a good fit and helps you to avoid cutting the covering or the first panel line. It also makes it easy to cut angled intersections.

As I noted earlier, you should avoid sealing the covering to the wood, except where necessary. Don't panic if this happens when you apply the panel lines. You can correct the situation using very sticky, "high-tack" tape, e.g., packing tape or electrical tape. Press a piece of it firmly on the covering, alongside—but not on—the panel line. (See Photo 9.) When you pull up the tape, the covering should be pulled up with it. If you really nailed it down, however, you might have to repeat this two or three times.

Follow these steps carefully, and your colleagues at the flying field will wonder how you managed to achieve such a high-quality trim job.



6. *Tack one end of the panel line down, stretch it across the surface, and then tack the other end.*



7. *Tack the center and then halfway between the center and each end. Tack at the midpoints between previous tacks until the strip is fastened in place. Then, run the iron down the panel line.*

8. *At intersections, a clear piece of acetate or plastic facilitates the cutting of a panel line that's square with the edge of the line that it overlaps.*

9. *If you accidentally seal the film to the wood while laying down a panel line, you can pull it up using tape; just don't pull on the panel line itself.*

Electric-powered British fighter

MODEL AIRPLANE NEWS MAGAZINE CONSTRUCTION

DeHavilland

HORNET

SPECIFICATIONS

Type: Sport-scale twin electric
Wingspan: 58 inches
Length: 48 inches
Wing area: 600 square inches
Wing loading: 24 ounces/square foot
Power: 2 Astro geared 05 cobalt motors;15 to 18 Ni-Cd cells
No. of channels req'd: 4 (elevator, rudder, aileron, throttle)

Features: easy battery-pack installation/removal from the assembled airplane (through the nose); positive battery-pack restraint designed into the fuselage structure; balsa/ply sandwich construction for high strength-to-weight ratio; molded papier-maché for light nacelle fairings.

Comments: this is a good-looking sport-scale model of the twin-engine Hornet fighter; variation in power and flight duration available with unique battery installation; good takeoff, flight and landing characteristics.

by ROY DAY

THE OPERATIONAL success of the Mosquito Bomber was the basis for the development of the deHavilland 103 Hornet. The Hornet was conceived as a long-range, high-speed fighter that would be capable of combating the Japanese in the South Pacific during World War II. To satisfy the requirements for long range and high speed, the Hornet combined the ultimate in streamlining with twin 2,000hp Merlin engines. While the Hornet reminds one of the Mosquito and did benefit from that successful airplane, it was, in fact, a completely new design.

The first prototype flew in July 1944, only 13 months after detail design had begun. The prototype's climb and speed were exceptional. It reached 485mph—a record for prop-driven airplanes.

Production and delivery of Hornets to the RAF did not begin until February 1945, so the war in the Pacific ended before Hornets could participate. They did, however, see considerable action as ground-attack fighters against the Malayan terrorists in 1951 to '54.

The Hornet was the last piston-engine airplane of the deHavilland line. Considered by many to be the ultimate in fighter design, it is unfortunate that not a single one has been preserved.

WHY A TWIN?

As a number of designers and builders have said, the electric-powered model is ideally suited to twins because there's no danger of "one engine out." The arrange-

ment of the two motors in series ensures that both are always powered.

Once it has been decided to model a twin, there are countless possibilities, from civil transports to bombers to long-range fighters. Few are modeled with gas engines because of the dreaded "engine-out" syndrome. For those who are interested in building electric twins, I strongly recommend Keith Shaw's article in the December '91 issue of *Model Airplane News*. Keith is a superb scale modeler and has been designing and building electrics—many of them twins—for years.

I selected the Hornet because it's aerodynamically clean and has very pleasing lines. It's well-proportioned for scaling as a model. The long engine nacelles and the sharply tapered wings give it a distinctive appearance in flight. The tapered wings are, however, a little more trouble to build, and washout is essential to avoid tip-stalling. The sleek configuration with adequate power provides a stand-off-scale model that performs well.

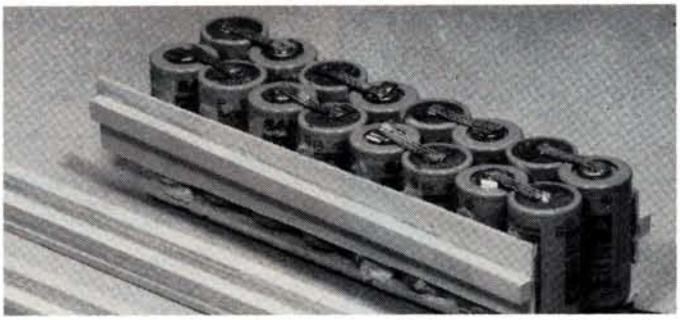
DESIGN FEATURES

- Easy battery-pack installation/removal from the assembled airplane (through the nose).
- Positive battery-pack restraint designed into the fuselage structure.
- Balsa/ply sandwich construction for high strength-to-weight ratio.
- Molded papier-maché for light nacelle fairings.

SIZING THE MODEL

Power system. The Hornet uses two of the popular size of electric motors—the AstroFlight* geared 05 cobalts. Following discussions with Bill Young, Scale Electric editor of *R/C Scale Modeler*, it was decided to use iron stator rings on the motors. The stator rings increase efficiency by completely containing the magnetic field. The rings are very thin and weigh less than 0.5 ounce each. They are inexpensive and can be bought from Hobby Lobby *.

On a test stand, using nine cells, I tested a single geared 05 with and without the iron rings. I measured current draw and rpm. With the stator rings, the motor showed about a 15 percent reduction in current draw with hardly a measurable drop in rpm. This current reduction translates into longer flight times.



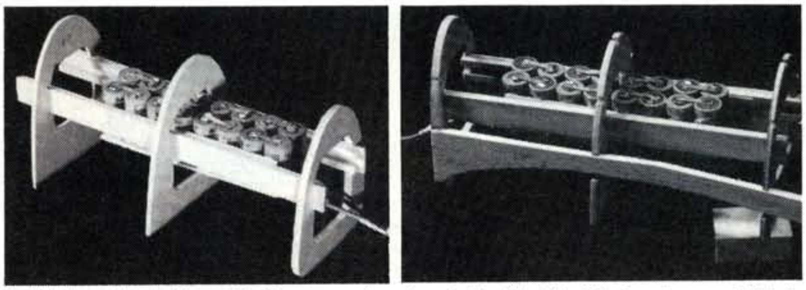
The battery-pack cells are glued together with silicone and held in the fuselage with a rail-and-channel system.

As long as the current is kept below 30 amps (the limit of the brushes), nine, or even 10, cells are acceptable with the 05 cobalt motors.

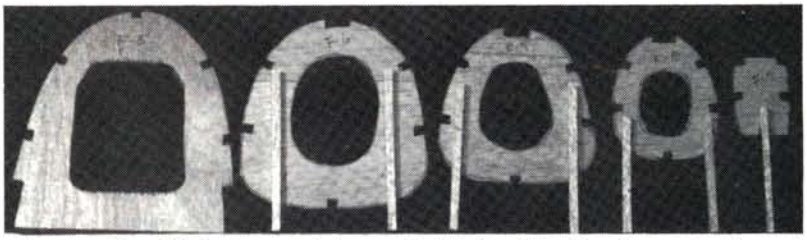
Based on these considerations, the power system is designed for 18 cells, and there's room for more if needed.

- **Weight and wing area considerations.** The general rule in electric-airplane design is to aim for an all-up flying weight of not more than twice the weight of the power system, i.e., the batteries and motors.

Working from three-views, the design was scaled to this wing area and the detailed construction plan drawn.



Left: The rail-and-channel battery-support system is the "keel" of the fuselage, and this is where the construction begins. Right: The strong, light, fuselage center section has formers made of cross-laminated balsa with 1/64 ply doublers.



Temporary jigs of 1/8-inch-square balsa are glued to the aft fuselage formers to raise each one to the correct height for assembling the fuselage.

HORNET WEIGHT AND WING AREA

FLYING WEIGHT = 2 x weight of power system

POWER SYSTEM WEIGHT: Two geared 05 cobalt motors =16 oz
Eighteen1200mAh cells =36 oz**
Total =52 oz

Therefore, The maximum all-up flying weight should be:
2x52 =104 ounces or 6.5 pounds.

For the Hornet, a wing loading of 24 oz/sq. ft. was chosen.

$$\text{Wing area} = \frac{\text{weight}}{\text{wing loading}} = \frac{(104\ \text{oz})}{(24\ \text{oz/sq.ft.})}$$

$$= 4.33\ \text{sq.ft.} = 624\ \text{sq. in.}$$

For the design, the wing area was rounded to 600 sq.in.

**A weight of 2 ounces for each 1200mAh cell was used for the design. An actual cell weighs closer to 1.8 ounces, but the rounded-up number allows for wiring, connectors, etc.

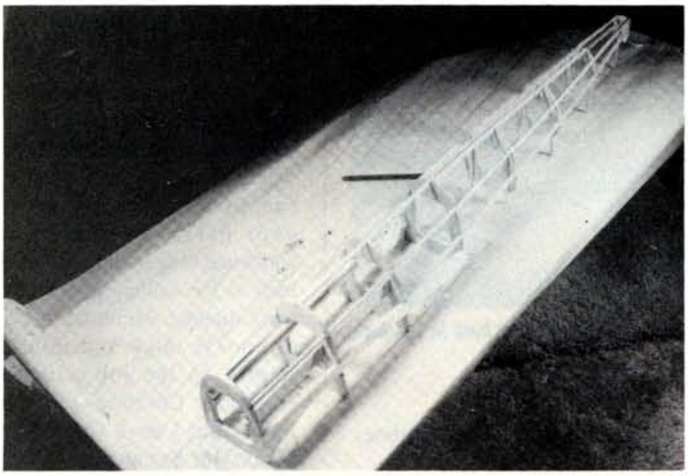
CONSTRUCTION

Attention to weight is crucial in electric-airplane construction. Use 6- to 10-pound/square-foot balsa wherever possible, except where something else is specified. Except for the ply doublers over balsa, use plywood/hardwood only in high-load areas such as the landing gear and the wing mounts. Minimize the use of epoxy; thick and thin CA should do the job with few exceptions. Covering can be any light film. I used Coverite's* Micafilm because it's light and strong.

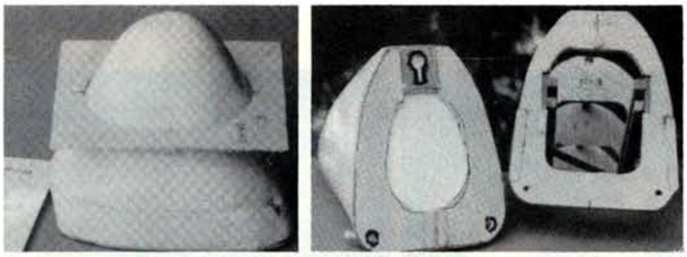
You will need a number of templates; SeeTemp* material is easy to use.

- **Fuselage.** Often, battery-pack accommodation is the last thing considered in the construction of an electric-powered airplane. For airplanes with a dozen or more cells (1 1/2 pounds of concentrated weight), I am convinced it should be the first consideration. That is how the Hornet design and the fuselage construction begins.

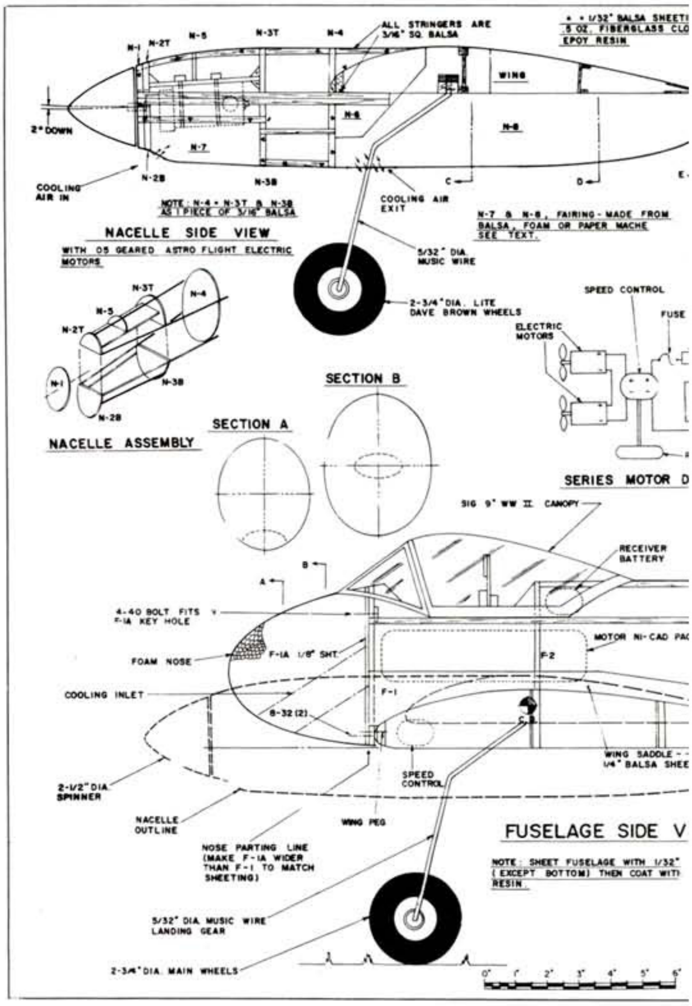
The fuselage's narrow cross-section will barely accommodate a 1200mAh battery pack. The most compact way to install it is by using a sliding-rail system. This rail arrangement holds the battery pack securely and allows quick installation through a removable nose. In addition, it



The fuselage is built over the plan with the temporary jigs on the formers. When the longerons have been glued, the jigs are cut off to leave a light, strong structure.



Left: the nose is made of white foam and shaped using templates. Coat it with laminating epoxy resin to give it a hard, slick finish. Right: the "quick-disconnect" nose allows easy access to the battery pack. Two 8-32 nylon bolts hold it at the lower corners, and a third bolt slides into a keyhole slot at top center.



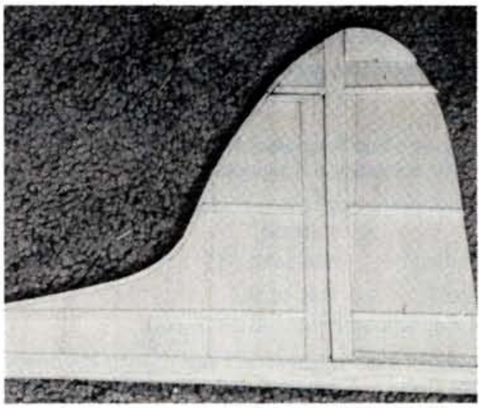
serves as a sort of "keel" for the fuselage and strengthens a high-load area. The batteries are glued together with silicone adhesive. If you can't make a pack at this time, then you should make an accurate mock-up so you can fit-check the rail assembly as you build the fuselage.

Now is the time to make the formers. For maximum strength and low weight, the formers are a sandwich of 1/64-inch-thick plywood and 3/32-inch sheet balsa. Refer to the table on the plan for the make-up of each former. Cross-laminate the sheet balsa at about 45 degrees, and then glue on the plywood. Then cut out the formers with your scroll saw. The composite formers are quite strong, yet light.

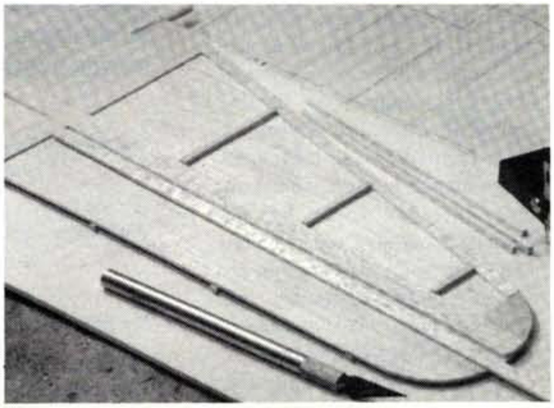
The entire fuselage will be built over the datum line at the bottom of the plan. Assemble the three formers and the two battery-pack channels, *but don't glue them together*. Check that the battery pack will slide freely, and then glue the assembly, ensuring that the formers are vertical and centered on the datum line. Next, glue in the ¼-inch sheet-balsa wing saddle.

The Hornet has a so-called "bent fuselage," so the remaining formers must be jigged up to the correct height above the datum line. Use 1/8-inch-square balsa as temporary jigs for each former. Glue in the top and upper longerons to the first three formers. Then install the remaining formers, being careful to keep them centered on the datum line to ensure a straight fuselage.

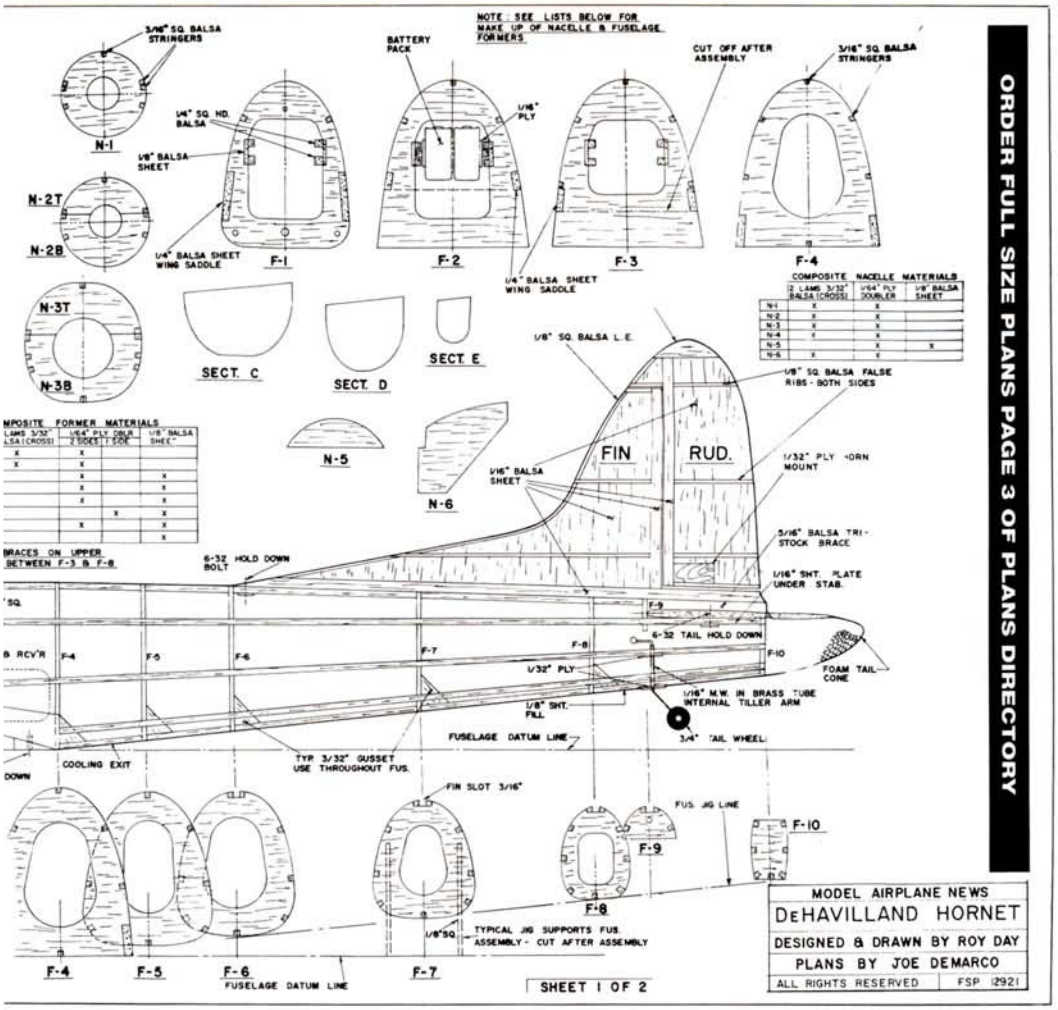
Because the entire tail assembly is removable, I chose to make a tail wheel that has an internal tiller arm connected to the rudder servo. Use 1/16-inch-thick music wire inserted into a brass tube that's held by 1/16-inch-thick plywood supports between the upper and lower longerons. Install your choice of pushrods before sheeting the fuselage with light 1/32-inch balsa sheet. To save weight, the bottom is not sheeted. The 1/32 sheet is easy to mold to the shape of the fuselage, but it is not rigid enough to prevent handling damage. I there-



The light, strong, tail surfaces are made with a center core of 1/16 balsa sheet and false ribs on each side.



Build the horizontal tail as one unit. After sanding to the final shape, cut the elevator away from the stabilizer.



fore applied one coat of thinned laminating epoxy (without cloth) to stiffen it.

Next, finish the cockpit with a pilot figure (I chose a Williams Brothers* standard pilot), then fit and install the canopy. The canopy must be in place before the removable nose is shaped because the nose slides up into place under the front of the canopy.

Using templates, shape the nose out of white foam. Use a filler like Goldberg's* Model Magic to fill any rough spots before you do the final finishing. To allow speedy removal, the nose has a three-point attachment. Two 8-32 nylon bolts at the lower corners hold it on the front former. A third bolt at the top center fits into a keyhole slot in the nose. Cut away about 3/4 inch of the foam at the two bottom corners, and install a short piece of tubing set in epoxy (to which you've added a filler to make a slurry). This will strengthen the corners where the 8-32 bolts hold the nose on the front former. Install threaded 1/8-inch-thick plywood blocks on the back of the front former to take the bolts. Use a 4-40 or a 6-32 bolt for the top nose attachment. This bolt is threaded into the front former (F1), and it protrudes about 1/8 inch to engage the keyhole slot in the nose.

To attach the nose, run the upper bolt through the keyhole slot, slide the nose up under the front edge of the canopy, and insert the two lower 8-32 bolts.

Put the fuselage aside now and move on to building the tail.

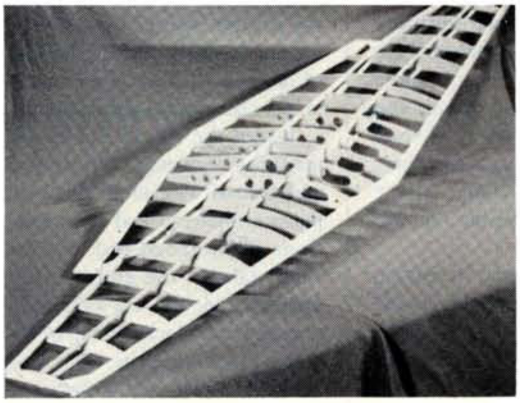
• **Tail.** I prefer removable tail assemblies. They make it easy to adjust the angle of incidence, and they simplify plane repair and transportation. Both the horizontal and vertical tails are built with 1/16 balsa sheet as the core.

Use your SeeTemp to make a template of the entire vertical tail. Cut the core out of 1/16 sheet, and glue on the 1/16 spars, 1/8-inch-square false ribs, tip cross-laminations and the strip along the base. Turn the tail over and repeat the process on the other side. Shape the leading edge and the ribs *before* you cut the rudder and fin apart. Cut lightening holes if you like (I didn't).

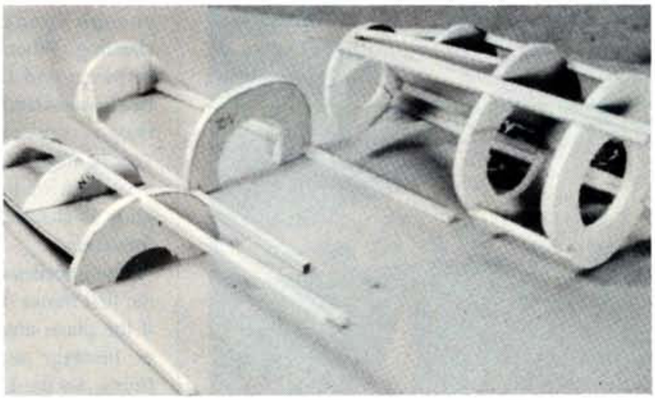
Build the horizontal tail in the same way. Bolt the stabilizer to the fuselage, and align the fin with the stab and then glue them together. Put a piece of triangle stock on each side of the fin where it sits on the stab to strengthen the glue joint. At the forward end of the fin, drill and tap the attachment points for the 6-32 hold-down bolt. The completed tail assembly should weigh 1.5 to 2.0 ounces.

• **The wing** is built over the plan. Before you glue in the ribs, remember to drill holes in them for the plastic-straw wiring conduit and the flexible aileron pushrod.

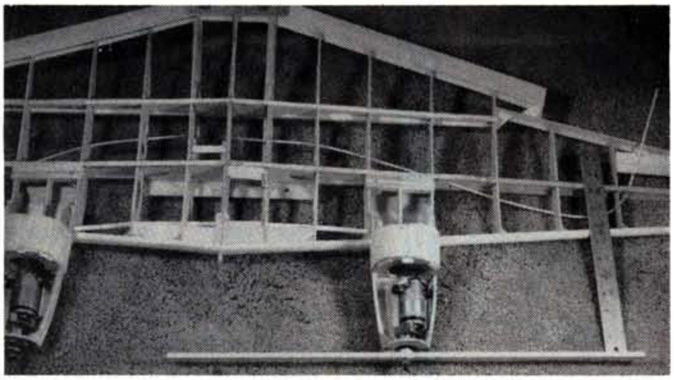
Lightening holes in the ribs reduce weight and also allow access to the wiring from the



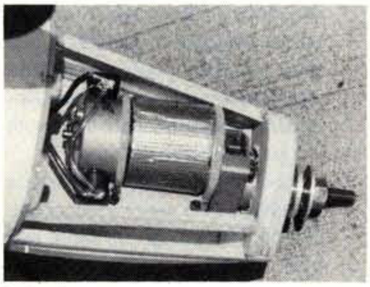
The thickness of the wing at the root, combined with the spruce spars, makes the wing strong enough without sheeting. Without the nacelles, the wing should weigh about 8 or 9 ounces.



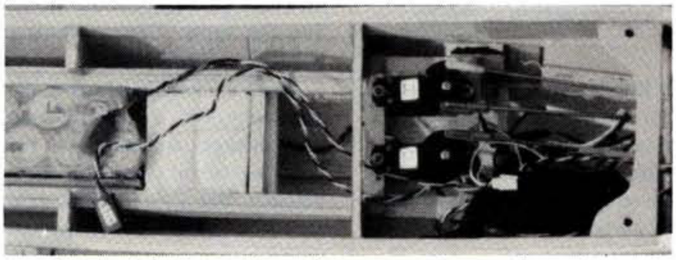
Build the nacelles in halves; join the halves; glue them to the wing. The nacelles have to be strong because they hit the ground in a nose-over.



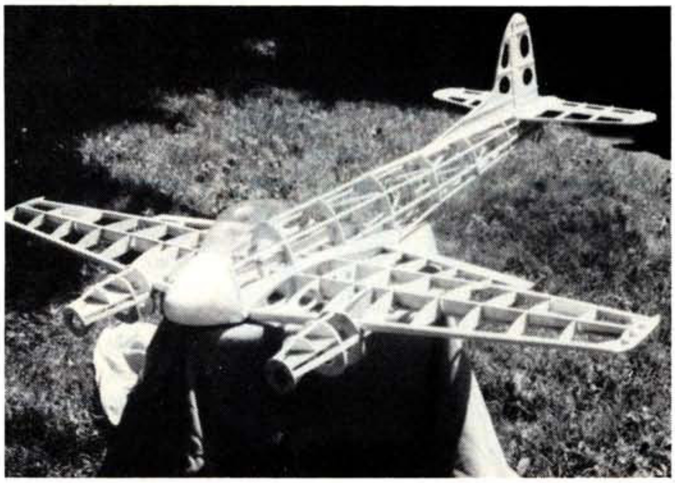
Using the spar as a guide, align the motors so they point straight ahead. There's no need to skew the motors, because there's no danger of an "engine out." The motor-mounting plate in the nacelle gives a 2-degree downthrust.



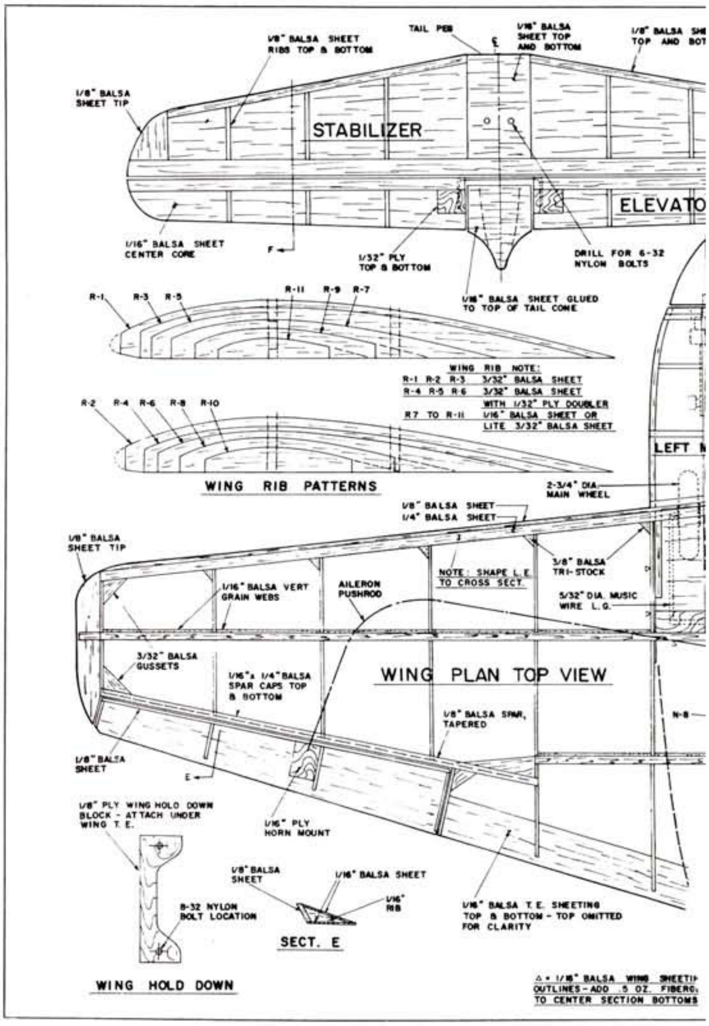
Left: the motors are reached through the bottom of the nacelle. They're firmly held in a vee-block mount with inner Nyrod straps. Right: the mold for the aft nacelle fairing is made of shaped blue foam. The papier-maché fairing is made with three layers of paper strips that are soaked in a water/glue mixture and then put on the mold to dry.



To minimize interference from the power system, radio equipment is installed as far aft as is practical. Note the battery pack installed in the sliding-rail system.



The Hornet's built-up structure is light (only 19 ounces) and strong.



arming switch and the speed controller.

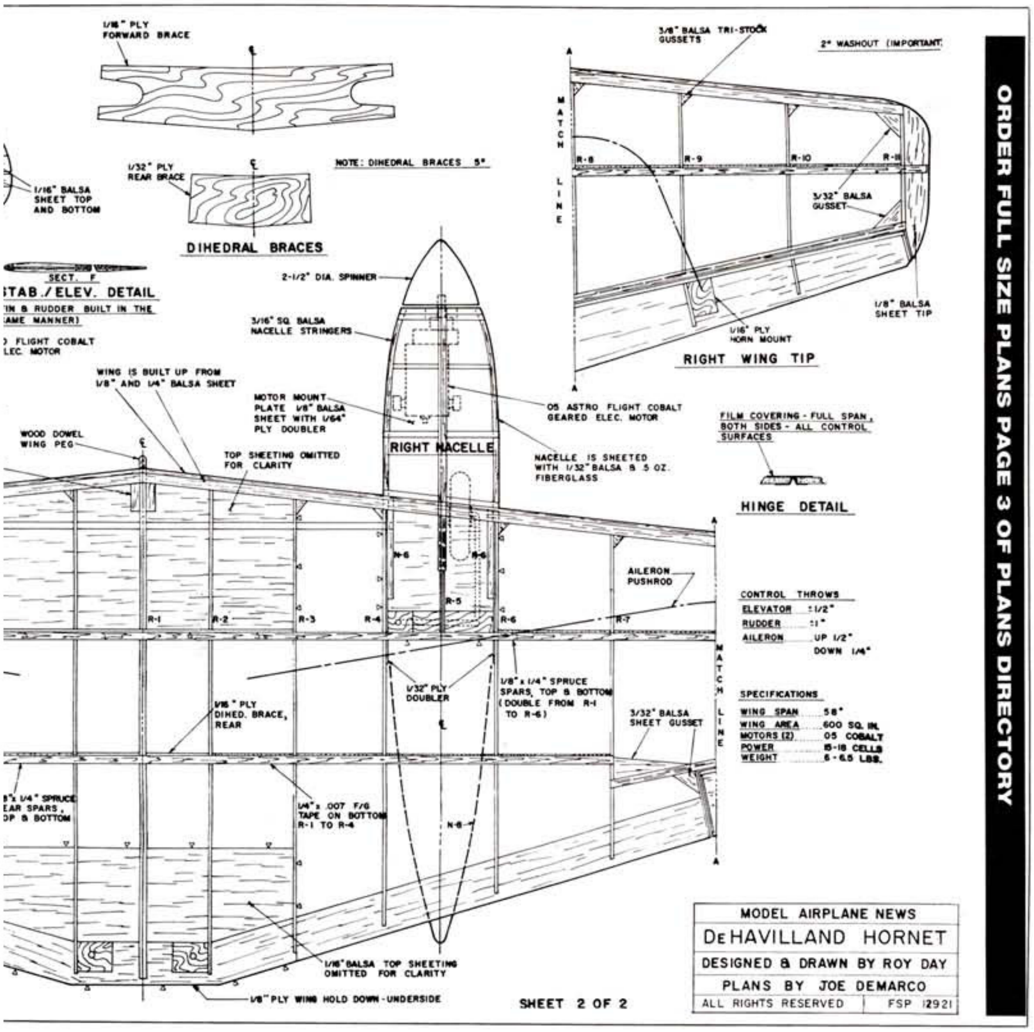
Join the two wing panels with the dihedral braces to give 5 degrees dihedral. Using thin CA, put 1/4x0.007-inch fiberglass tape on the bottom of both spars. (I use Future Flight* tape.) The completed wing should weigh about 8 or 9 ounces.

This wing is thick at the root, and the spruce spars provide enough strength without any sheeting. When the nacelles are in place and the motors have been installed, however, the wing is very nose-heavy. To prevent handling damage, therefore, a section of the center of the wing is sheeted on the bottom, fore and aft.

• **The nacelles** on the Hornet are the first things that hit the ground if the plane noses-over. There is no fuselage nose to protect the props, so the nacelles are built stronger than would be necessary for a more conventional twin.

Build the nacelles over the plan using the horizontal-crutch method. The upper and lower sections are built separately and then joined. The material for the composite formers is given on the plan. The motor-mounting plate is angled to give 2 degrees of downthrust. Align the nacelles on the wing with 0 degrees of side thrust and 0 degrees downthrust so they're level and pointing straight ahead. Because we are not concerned about the loss of one motor, there is no reason to skew the thrust lines outward.

Install the motor and check the thrust alignment. The motors are secured with inner flexible-pushrod material and short sections of threaded rod. Solder small tabs to the end of each threaded rod, and use 4-40 bolts threaded into blocks on top of the motor-mounting plate. This will allow the motor to be installed or removed through the opening in the bottom of the nacelle. Sheet



the nacelle with 1/32-inch sheet balsa, and cover it with thinned laminating epoxy resin and 0.5-ounce/square yard fiberglass cloth.

All that remains now is the building of the chin cowl (N7) that covers the motor access and the long fairing (N-8) that extends back to the wing trailing edge. These are fairings only; they carry no loads, and should be made as light as possible of balsa, foam, formed plastic or papier-maché (my choice). Here's how they're made.

Out of blue foam, make male molds in the shape of the chin cowl and the long fairing. Fill the foam as required with Goldberg filler, and then finish it with a coat of laminating epoxy resin to give it a hard, slick surface.

Now cut some brown grocery bags into 3/4x8-inch strips, and then soak the strips for a few minutes in a solution made of one part water to three parts aliphatic-resin glue.

While the strips are soaking, apply a couple of coats of paste wax to the foam molds. Then lay the paper strips diagonally over the mold, alternating the direction of each layer. Three layers will be enough.

Allow the paper to thoroughly dry (about 24 hours). While the fairings are still on the molds, finish with filler and sand the surface smooth. The papier-maché has the qualities of molded plywood; it can be cut and painted as you'd cut and paint any wooden part.

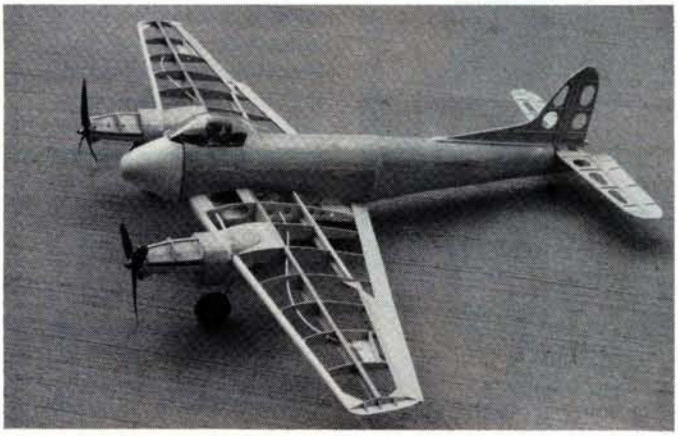
Cut cooling air holes in the chin cowl, and cut an opening for the landing gear in the long fairing. (This will also serve as an outlet for the cooling air.) After the model has been covered, attach the fairings with plastic tape. (See the July '92 issue of *Model Aviation* for an article by Day and Mecklenburg on how to make papier-maché cowls, fairings, etc.)

FINAL ASSEMBLY

All that remains is the installation of the radio and the wiring. A Jomar* SM-4 speed controller is mounted in the wing with its heat sink on the bottom surface. The arming switch is installed on the top surface of the wing near the cockpit so that it can be reached from behind—out of danger of the props.

With the arming switch and the speed controller in the wing, only the two battery connections and the controller and aileron

(Continued on page 94)



All that's left to do is the sheeting of the tops of the nacelles and the application of covering.

PHOTOS BY ROY DAY

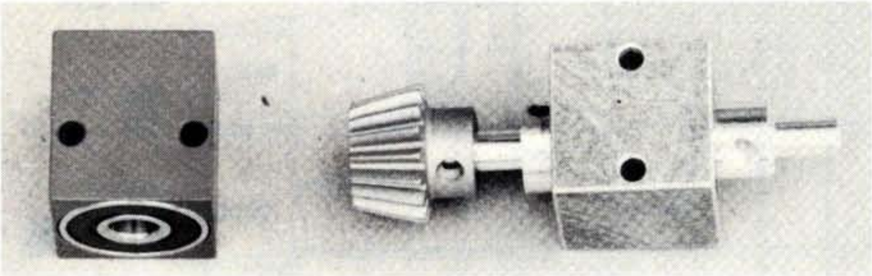
The electric Hornet has the same sleek lines as the full-scale deHavilland fighter.

PRODUCT REVIEW

Bennett BEARING BLOCKS

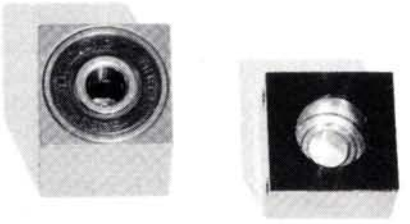
All-aluminum, double-bearing, X-Cell upgrade

by MIKE CINGARI



Close-up of the 50/60 double bearing block for the start shaft (left) and the front tail-drive housing bearing block (right) with front-drive pinion shaft and gear installed.

CLIFF BENNETT and Larry Bergen have developed a line of high-quality accessories for the Miniature Aircraft* X-Cell series of helicopters. These include Bennett Bearing Blocks*—two, new, all-aluminum bearing blocks that replace the stock, single-bearing blocks. Bennett aluminum blocks strengthen the side-frame assembly tremendously, and the two, high-quality ball bearings installed in each block precisely maintain the alignment of the starter shaft and front-drive pinion shaft as your machine accumulates flying time.



The Bennett 50/60 starter-shaft bearing block (left) and the stock bearing block (right).

The new bearing blocks also help to break-in the molded-nylon main drive gear properly. They provide a smooth, consistent gear mesh that minimizes the need for further adjustments or maintenance of the main drive gear and pinion gears. Adding these bearing blocks to your X-Cell will help make it a state-of-the-art helicopter.

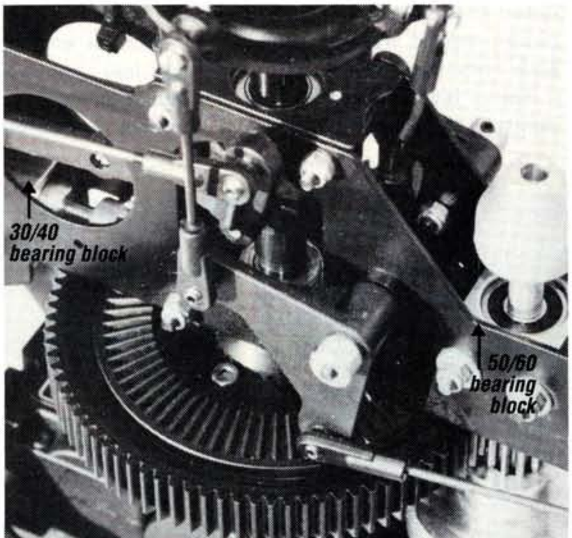
FEATURES

The all-aluminum block for the starter shaft comes in two sizes: the 50/60-size block has two, 6mm-i.d. bearings, and it's a direct replacement for the stock, single-bearing block on the X-Cell 50/60 series. The 30/40-size block has two 5mm-i.d. bearings, and it's a direct replacement for the stock, nylon, bearing block on the X-Cell 30/40 series. It can also be used as a direct replacement for the plastic, front, tail-drive housing on all of the X-Cell series. The 50/60 bearing block has been anodized in blue, whereas the 30/40 bearing block/front tail-drive housing is black anodized. Both bearing blocks can be adapted to fit other helicopters.

INSTALLATION

To install the front bearing block on the X-Cell, first remove the starter cone and the two, front, bearing-block bolts. Then, lift the original bearing block off the start shaft. When you install the bearing block on the start shaft, be sure to apply a small amount of green Loctite* so that the shaft doesn't spin in the inner bearing race. Install the block, check the gear mesh and tighten the two through-bolts. Add the starter cone, and the job is complete.

To install the front tail-drive housing block, remove the tail boom in order to access the bearing block. It took me less than 30 minutes to replace both my blocks on my X-Cell 40.



Close-up of the X-Cell 40 with the start-shaft bearing block and front tail-drive housing bearing block installed.

CONCLUSION

The new Bennett Bearing Blocks make a great helicopter even better. Installation is quick; they require no maintenance; and they've shown virtually no wear after many hours of use. If you're looking for high-quality, high-performance bearing-block replacements at a reasonable price, these fill the bill.

**Here are the addresses of the companies mentioned in this article:*
***Miniature Aircraft USA,** 2324 N. Orange Blossom Trail, Orlando, FL 32804.*
***Bennett Products and Bergen Machine & Tool,** 17013 Lake View Dr., Vandalia, MI 49095.*
***Loctite Corp.,** 4450 Cranwood Ct., Cleveland, OH 44128.*

PHOTOS BY TOM ATWOOD

What makes this new direction in modeling so intriguing? Is it that Walter Mitty resides in all of us? Most of us will never get very close to the controls of the space shuttle. This is just the ticket for us would-be astronauts. Besides, the astronauts don't get to do victory rolls continuously all the way up on the launch, or consecutive loops on the return to earth!

CONSTRUCTION

The model, with radio gear and rocket motor installed, weighs between 12 and 16 ounces. It isn't a big project if you have a couple of planes under your belt. The model uses thin, flat-bottomed, sheeted, foam-core wings. The instructions suggest that you attach the 1/32-inch-thick balsa skins to the foam with 3M 77 spray adhesive. This is one of the lightest adhesives, but if you use it (or spray

ESTES

Astro Blaster

The next generation in R/C?

Above: the Astro Blaster flies well under glow power. The conversion requires that the battery be moved forward in the fuselage to preserve the CG position. Right: columnist David Baron holds the sticks while Senior Editor Chris Chianelli ignites the Astro Blaster's rocket engine.

by DAVID C. BARON

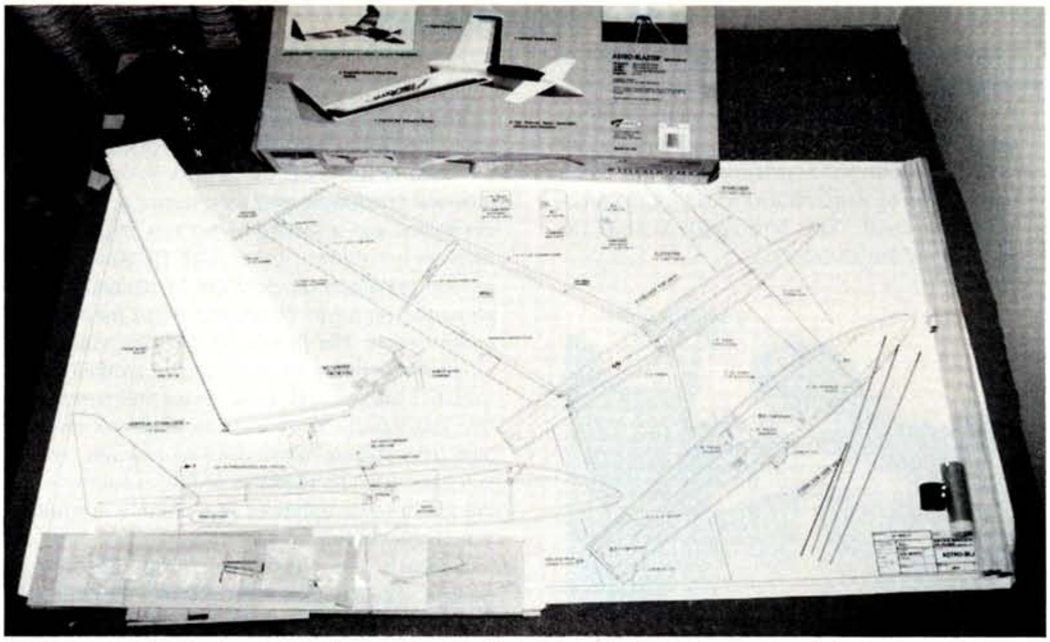
AS IT RISES from its pad, the Astro Blaster sets the mood of a real space launch. You see first-hand the fiery exhaust surging from the tail, the acceleration into the sky. When the smoke clears, the model is high in the sky (orbit?), searching for thermals.

adhesive of any kind), make sure that you don't breathe in *any* of the fumes (better to attach the skins outside with the wind at your back—if you can smell the adhesive, you're doing something wrong).

After you've sheeted the wing, add the leading edge, the subspar and the trailing edge according to the directions, and then epoxy the wing halves together. Torque rods pivot the 1-inch-wide ailerons up and down ⅜ inch—standard fare.

The fuselage is of simple box construction. You must make a series of razor cuts along one edge of the triangle stock (to allow bending) so that you can then glue it to the curved edge of the fuselage sides. This stock anchors the top and bottom fuselage sheeting. After you've installed the B1 and B2 formers, pull the front ends of the fuselage sides together to create the tapered nose of the airplane. After you've sheeted the fuselage tops and bottoms, fit the wing into the fuselage. Then, cut the access hatch from the fuselage.

The elevators and stabilizers are all of standard slab construction, and the engine mount is a very simple tube mount. All of this makes for a very quick-to-build airplane.

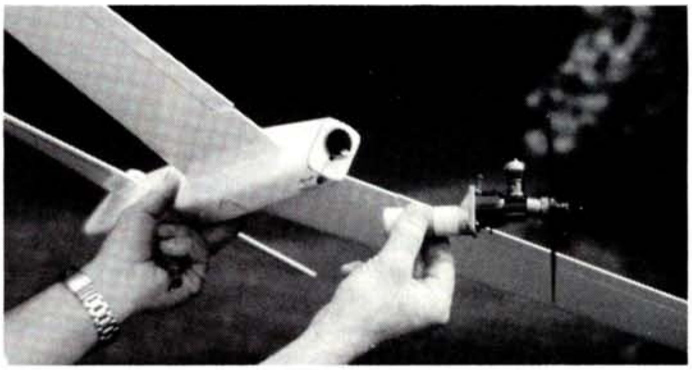


As is suggested by the single plan sheet, the construction of the Astro Blaster is simple and straightforward. A sheeted-foam wing is inserted into a box fuselage. The 10-page instruction book includes 19 photos and several line drawings of different assemblies.

MONSTER MOTORS?

D-11P motors are recommended in the instructions. Since there are other rocket motors available, it's natural to wonder if they would provide added performance for the Astro Blaster. We tested another brand of composite motor in the Astro Blaster—one with far greater power than the D-11P. Within 150 feet of takeoff, the model exceeded its terminal velocity, and the forward stab separated from the ship. The Astro Blaster could be modified to withstand the stresses of such motors, but for safety's sake, use the recommended motors in a stock kit. Estes is coming out with its own composite motors for higher-altitude flights. The word is that these motors will have a restricted nozzle that will prevent the plane from achieving speeds that will cause it to break up.

"This new aspect of our hobby needs only a little imagination to grow into a tremendous sport of its own."



A Cox Tee Dee engine is mounted to a firewall that's attached to an empty rocket motor tube.

Model name: Astro Blaster
Type: Rocket/glow/slope R/C aerobat
Price: $74.99
Wingspan: 36 inches
Wing area: 234 square inches
Wing loading: 8.6 ounces per square foot
Weight: 12 to 16 ounces ready to launch
Channels req'd: 2 (ailerons, elevator)
Radio: Any light 2-channel
Power Req'd: D-11P Estes rocket motors, or ½A glow engine
Prop used: 6x2 pusher
Airfoil: Flat bottom
Wing construction: Balsa sheeted foam-core
Fuselage construction: Balsa-and-ply box construction

Features: the kit includes balsa parts, ply formers, foam-cores, sheeting and hardware for linkages.

HITS
- Novelty of rocket launch will put a smile on nearly any R/C modeler's face.
- Strong, light construction; fast to build.
- Highly maneuverable 2-channel design can be flown with rocket or glow power, or on the slopes.

MISSES
- Launch height with D-11P motors only permits short gliding flights.

FLIGHT PERFORMANCE

• Blastoff

For the brief moment that your model starts to move off the pad, the fire coming out of the tail is longer than the fuselage—and the noise seems to be louder than that of any of the rockets of my youth. This bird really gets off the pad fast, so don't blink.

PHOTO BY RUSS PRIBANIC

One caution: unless you're desperate to change the Astro Blaster's course immediately after takeoff, don't touch the elevator control in the first few moments of launch. It's accelerating hard and temporarily achieving speeds that would shed the wings of an average sport ship. The elevator gets hyper-sensitive so resist the temptation to touch it during launch—resist! If the plane seems to desperately need elevator correction during launch, then I suggest that you give it aileron instead. This will give you a wobbly vertical roll (barrel roll), but it will absorb the pitch problem and keep the plane headed vertically.

After the engine has quit, you'll have plenty of time to fine-tune the elevator trim. The designers at Estes did a fine job setting up the thrust line of the engine so that there isn't a noticeable trim change between engine on and engine off.

For the moment, the D11-P rocket engine is the only engine available. There are more engines due soon, so don't be concerned about the lack of power options. The D11-P motor isn't wimpy. It gets the ship to 250 or 300 feet in about a second. It's a sensible motor to use while you explore the new capabilities of rocket powered R/C flight.

• Multi-stage launches

We experimented with the problem of how to achieve higher launches. There are many "D"-size booster rockets available, so, using standard model rocketry techniques, we modified the aft motor housing tube to accept a second stage. If you're going to try this, be sure to have an experienced rocket modeler on your team. We put a ¾-inch spacer (a piece of a spent motor) into the motor housing so that when the D-11-P was installed, it extended out the back of the plane by ¾ inch. A cardboard tube was friction-fit over the exterior portion of the motor, and a second motor was friction-fit into the cardboard tube. The fit was tight enough to hold the booster, but loose enough to allow the motor to be ejected when the main motor ignites. The fit was achieved by winding an 18-inch ribbon of crépe paper around the rocket. Tape one end to the motor and tape the free end loosely to the outside of the aft fuselage (this ensures unwinding on ejection, and you can track the motor as it falls). Tubing of the appropriate diameter is available at your local hobby shop.

Even though the booster substantially changed the CG of the Astro Blaster, this didn't prove to be a problem on launch; the plane never gets a chance to fly on its wings while tail-heavy. With the booster, the Astro Blaster achieved altitudes of 600 to 700 feet. The extra altitude is achieved because the plane is already in motion when the second motor kicks in!

• Flying with a glow engine

Hand launches were unique but not dangerous. (I suggest that the thrower wear a glove on his launch hand.) The Astro Blaster has such a wide speed range that it's safe and predictable from hand launch to cruise speed.

When using the gas conversion, change the location of the battery pack so that the CG is still properly located. For rocket launches, place the pack behind the aileron servo. When using the gas motor, move the pack to the nose, under the receiver.

Although there's nothing difficult about flying the Blaster, the glow conversion allows valuable additional time for getting accustomed to the tail-first shape in the air, and for passing the transmitter around.

• Aerobatics

Keep in mind that there's only elevator and aileron. This precludes some of the snap-and-spin maneuvers, but there's still a lot of life in the Astro Blaster. Because it has such low drag and a light wing loading, it's a very nimble creature that needs only to keep up its momentum to achieve continuous rolls—and even loops if you give away a foot or two of altitude with each loop.

Four-point rolls are lessons in energy management. Get the plane to high speed and give away only a minimum amount of altitude with each point, and everyone will swear that it seems to glide as well on its side (and its back), as it does right-side up! Inverted flight is very predictable for a flat-bottom wing. It definitely loses some efficiency, but that won't keep the hot-doggers out there from doing fast, low, inverted flybys just before landing.

GLOW POWER!

Yes, you've read it correctly. Estes has a "plug-in" glow option so you can enjoy your Astro Blaster after you've used up all your rocket engines! Of simple design, it's a dummy rocket motor that has a firewall on it. Our test ship used a Cox* Black Widow .049 and a 6x3 pusher prop. This made for great climbs, but I'm sure that a 5.5x4 pylon racing prop would provide the speeds that the Astro Blaster is more at home with. With the engine on the back, it would take only a little cosmetic surgery to achieve the "Vari Eze" look.

THE FUTURE OF ROCKET-POWERED R/C?

I can't help but dream of the countless scale applications that are possible. Imagine a little ME-163, or an SR-71 blasting off the pad! They could be very inexpensive and easy to build, too. Judging from the light wing loading of the Astro Blaster, I think that you could build a model with less wing area that would still have excellent performance. The other benefit of a smaller wing might be (depending on the model) a lower frontal area. This would reduce drag and give you higher launches.

This new aspect of our hobby needs only a little imagination to grow into a tremendous sport of its own. Time to sharpen the drafting pencil!

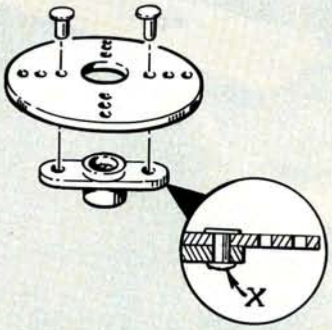
*Here are the addresses of the companies mentioned in this article:
Estes Industries, *P.O. Box 227, Penrose, CO 81240.*
Cox Hobbies, *350 W. Rincon St., Corona, CA 91720.*

NOTE: Estes does not endorse staging of the Astro Blaster.

HINTS & KINKS

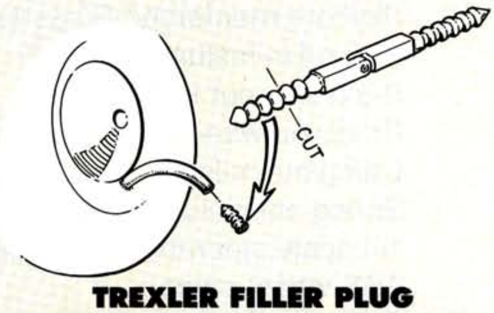
JIM NEWMAN

Model Airplane News will give a free one-year subscription (or one-year renewal if you already subscribe) for each idea used in "Hints & Kinks." Send a rough sketch to Jim Newman c/o *Model Airplane News,* 251 Danbury Rd., Wilton, Ct 06897. BE SURE YOUR NAME AND ADDRESS ARE CLEARLY PRINTED ON EACH SKETCH, PHOTO, AND NOTE YOU SUBMIT. Because of the number of ideas we receive, we can't acknowledge each one, nor can we return unused material.



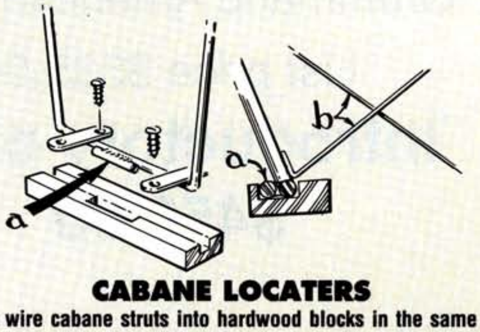
SERVO WHEEL ADAPTATION

If you need a 3-inch servo wheel for your Airtronics radio but can't find one in your local store, buy a 3-inch Futaba wheel instead. Use the heads of aluminum nails as rivets to fasten the larger Futaba wheel to the Airtronics servo arm. ***Dick Bruckner, Grove, OK***



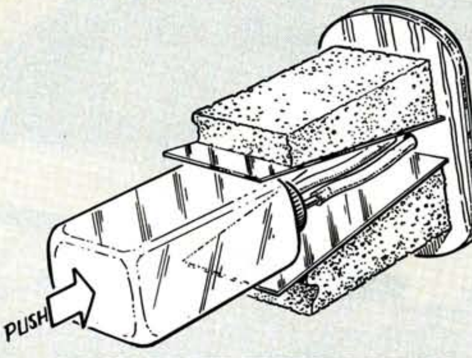
TREXLER FILLER PLUG

If you twist and fold the inflater stem of a Trexler air wheel, you run the risk of flattening it and having the sides stick together. To avoid this, cut a short piece off a Robart Hinge Point, as shown. Use it as a leak-proof plug, and push it into the stem before you tuck the stem out of sight behind the wheel hub. Allow the plug to protrude so that you can grip it with pliers to remove it. ***Bill Strahle, Milford, DE***



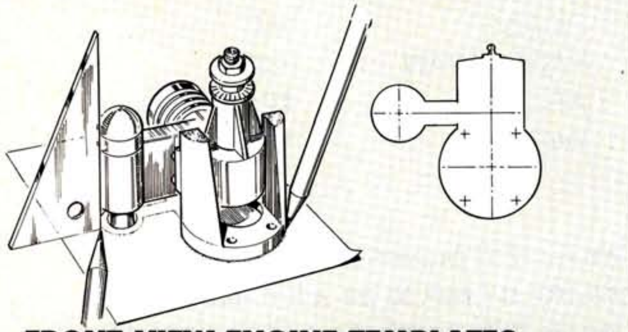
CABANE LOCATERS

Set these wire cabane struts into hardwood blocks in the same way as you'd attach landing-gear legs and using the landing-gear straps. Tilt the strut to the required angle, then solder the locater (a) to the wire and epoxy the assembly solidly into the slot to prevent the cabane from rotating. After you've set the cabane angle, solder diagonal bracing wires (b) into place to take drag and anti-drag flight loads. ***Harry Braunlich, Victor, NY***



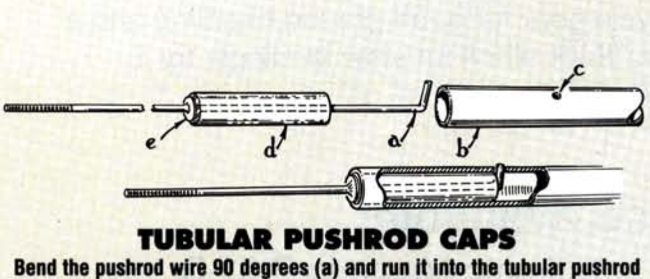
EASY TANK INSTALLATION

If you put a pair of metal plates into the fuel-tank compartment before you insert the fuel tank, the tank will slide neatly into place without pushing the foam rubber out of shape. Remove the plates after you've positioned the tank. ***Bill Watson, Hendersonville, TN***



FRONT-VIEW ENGINE TEMPLATES

To position the muffler, make a front-view template of your engine. After cutting a hole in a piece of cardboard for the exhaust pipe, put the engine and mount assembly onto the cardboard and trace around them, as shown. Before you cut out the template, mark the positions of the mounting holes, too. ***Fred Schmidt, Livonia, MI***



TUBULAR PUSHROD CAPS

Bend the pushrod wire 90 degrees (a) and run it into the tubular pushrod (b) so that the short leg of the wire pops out through the hole (c). Smear epoxy over the dowel plug (d), then insert it into the pushrod. You can solder a washer (e) onto the wire, against the plug, but it isn't necessary. The short bend in the pushrod wire ensures that control-surface loads are mechanically transferred to the pushrod and don't have to rely on an epoxied joint. ***John Roberts, Acworth, GA***

SEAPLANE CLOSEUPS

Richard Lucas's Cams 38 Schneider racer heads out for taxi trials. This 40-pound, A&M 4.2-powered ship was repaired after a bearing failure caused it to crash during its third flight. The Cams was the last flying boat/biplane configuration to compete in the Schneider Races. The original project took 1,500 hours, and the rebuild added another 100 hours.

The 4.2ci A&M powerplant is barely visible in its pusher configuration installation. Stitz aircraft paint was used throughout, including for the simulated-aluminum cowl finish. Note the incredible wing-covering details.

Leon DeLisle displays his 120-inch-span, 26-pound, scratch-built Ladaco finback—an original design. It has a 22x12 prop. The leading rake on the tip floats is set at 30 degrees. When pushed hard, these tip floats can really push back and keep the seaplane upright. The vertical fin on this giant is 23 inches tall!

The shallow cowl and right cheek panel on the finback are removable for convenient engine access. A $^1/_2$-inch copper exhaust pipe is "rubber-sleeved" into an aluminum exhaust extension. The sound is distinctive, and fuel residue is kept to a minimum.

Phil Baben shows us the camera bay on his multipurpose Senior Telemaster. For water use, the 35mm Nikon pocket auto is gasket-sealed with a clear Plexiglas cover plate. Extra-wide flat float soles were added to keep drops of spray off the cover plate. The Nikon is servo-actuated.

Phil Baben's scratch-built vee-tail glider returns from a high release from a Telemaster. Seven-minute flights in dead air are the norm. The vee-tail is actuated by a Du-Bro mixer. The stepless, flat-bottom glider floats are made out of foam cylinders used for Christmas decorations.

4 FASCINATING FLOAT-FLIERS

by JOHN SULLIVAN

IF YOU'RE JUST getting into float flying, and you're of the impression that floatplane activity is restricted to .40-size trainers on "quickie" floats, look again. The planes pictured here would draw a crowd at any land-based flying site in the country, yet they all enjoy the additional realism that water-based operation affords.

To a growing fraternity of float fliers, there's just nothing to equal the sight of a floatplane plowing through the water in displacement mode with the bow wave spreading out placidly behind it. Nor is there any equal to a seaplane blasting up on step, sending up rooster-tails in long, straight, high-speed runs, or the spectacle of takeoff with a shower of spray glinting in the sun as it falls back onto a still, quiet lake.

Floatplane flying is the ultimate when it comes to realistic radio-controlled aircraft operation, and, if Phil Baben's Telemaster project is any indication, seaplanes can do everything except return your calls. Finally, here's another bonus: water is softer than land. Your creations will last much longer and provide many more months—even years—of service as floatplanes.

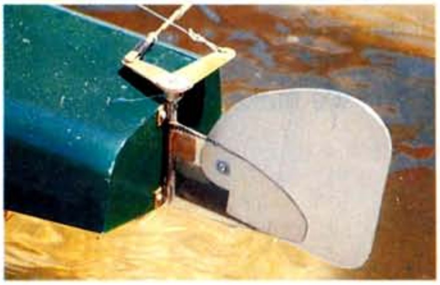
One last note to forestall any inquiries regarding the planes in this article: the Telemaster is available from Hobby Lobby*, and *Model Airplane News* offers plans for the Liberty Sport Bipe, but all of the other craft were scratch-built, and no plans are available for them. It's time to stop babbling (pun intended). Give seaplanes a try soon. You may never go back to that hard runway!

**Here's the address of the company mentioned in this article:*

Hobby Lobby International, *5614 Franklin Pike Cr., Brentwood, TN 37027.* ■

PHOTOS BY JOHN SULLIVAN

We asked Cathy to help us demonstrate just how big Richard Lucas's 8-foot scratch-built Liberty Sport Bipe really is and then forgot to ask for her last name. The Liberty Sport was built from MAN plans (July '86). Note the sub fin. When the sub fin approaches 20 percent of existing vertical fin area, it helps to counteract the aerodynamic effects of the frontal areas on the floatplanes.



The Liberty Sport kick-up water rudders are actuated by a single pull wire going to each rudder with a slave wire between them. This neat setup eliminates much complexity and works well.

Design, Build

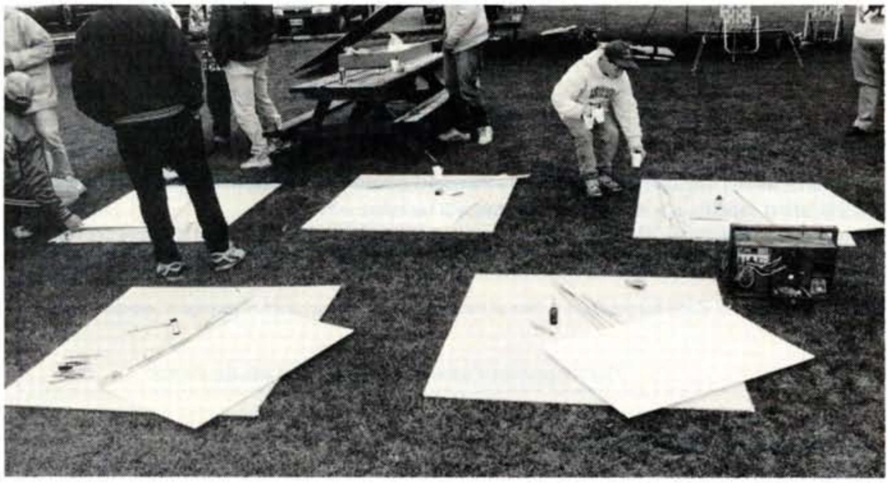
The ULTIMATE Fun-Fly Event?

by TOM ATWOOD

THE KINGSTON R/C Modellers' annual fun flys, held in Kingston, Ontario, Canada, on Father's Day weekend, have developed a notable reputation among modelers in the northeastern U.S. and south central Canada who have been lucky enough to attend the event. These annual fun flys are known for the pleasant surroundings—Canadian forest redolent with the fragrance of pine trees, and a large flying field that looks something like a perfectly flat golf-course fairway. The Kingston R/C Modellers always show generosity and a warm fellowship that makes anyone who makes the trip feel very much at home.

The club members dedicate themselves to making the fun fly as enjoyable as possible; this includes refraining from flying so that guests will have more air time, preparing a major cook-out feast and running a very well-organized event right down to the details of frequency control. Both the U.S. and Canadian anthems are played at the start of the fun fly—a nice touch and a symbolic across-the-border handshake.

The 17th annual Kingston Fun Fly was held on June 20 and 21. Timed and mission events were flown, and a new build-and-fly event was introduced. The timed event included 10 nose-down spins, a touch-and-go, five vertical loops, a touch-and-go, five horizontal rolls, a touch-and-go, a climb to altitude followed by 10 deadstick, nose-down spins and a deadstick spot landing. The mission event included a bomb drop, a balloon break and a spot landing.



Top: the five fun-fly "kits" await the competition. Wallboard material provided a building surface on the grass. Above left: Team Crash is victorious. Members included Wynn Aker, Dan and Steve Luchaco, Tim Rogers, Jamie Burke and Russ Carpenter. Above right: the Death Seekers toil as the clock ticks.

WINNERS' CHART

Team name	Minutes to design & build	Total
1 Team Crash	43	-5
2 Screamin' Siemons	36	-2
3 Death Seekers	41	0
4 Team Barlee	43	10
5 Wympodytes	34	34

DESIGN, BUILD AND FLY!

The new event stole the show on the second day of the meet. Dubbed the "Connecticut Challenge" because it originated among a group of Connecticut modelers, this event entailed the on-the-spot design, building and competition flying of an airplane (see sidebar). The originators of the event weren't sure how successful the planes would be, but the spirit of the Kingston Fun Fly guaranteed that contestants would give it their best.

FLYING COMPETITION

Although the airworthiness of any of the designs wasn't known, the flying competition was, nonetheless, optimistically structured. It included a straight flight (at least 100 yards, straight and level, 3 points); a figure-8 (showing coordinated left and right turns, 5 points); loops (at least one, 10 points); spins (one point per revolution, up to 10 points); a touch-and-go (10 points); and a pylon race of five laps around two pylons (1st place—10 points, 2nd—5 points, 3rd—3 points).

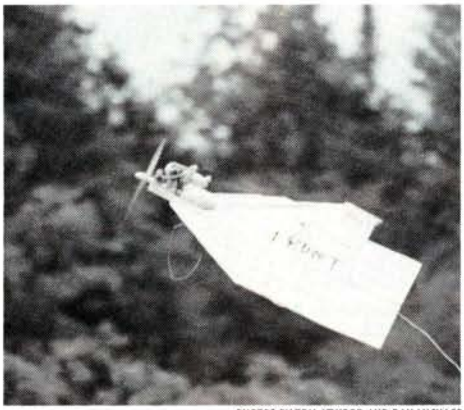
THE CONTEST BEGINS

Intense excitement was in the air as building materials were handed out, and the tension grew as each team decided on a design and began construction. Teams were sufficiently dispersed

and Fly...

to protect their design secrets. Fascinated spectators, eyes wide, gave smiling support to the teams' efforts. The last rounds of the timed and mission events were abandoned as everyone at the flying field became engrossed in this novel build-and-fly contest.

Above: the Wympodytes' Roun' Tuit clone at the zenith of its best non-flight. Top right: the Screamin' Siemons at work. Note the unconventional double fin. The plane flew well. Right: Team Crash's aircraft head out for competition.



PHOTOS BY TOM ATWOOD AND DAN LUCHACO

As I walked from team to team, a pattern began to emerge—four of the five teams built basic delta or flying-wing designs. No matter that the sponsors of the Connecticut Challenge had brought a plane with a standard planform and built it in under 45 minutes with the materials provided. Different fin and stab arrangements began to appear. Only one plane was built with a rudder.

All eyes were on the field as the flying portion of the contest began. One team—the Wympodytes—tried what surely seemed to be a successful formula—a simple knock-off of the Roun' Tuit design. They built it in only 34 minutes. (It would have been shorter if a last-minute programming glitch hadn't emerged at the worst possible time.) After being flung into the air, it just as quickly nosed over into the ground. Back to the hangar for repairs and an enlargement of the elevator! Another "test crash" showed that these efforts were to no avail. The plane never flew.

The Death Seekers' plane after nearly a dozen flights. They took 3rd.

Team Crash brought out a well-thought-out flying-wing design—two fins angled in to form a triangular-shaped structure that added strength. The plane was tossed into the air and flew straight as an arrow. A cheer from the crowd swept through the drizzly, misty air that had uncharacteristically (for this time of year) descended on the field. Then, the other planes followed. Remarkably, four of the five airplanes flew ably, and only a couple required some quick handiwork and trim adjustments to provide the necessary control authority.

THE WINNERS EMERGE

All four planes quickly completed loops, straight flight, spins and a figure-8. Only

(Continued on page 99)

Note the touch-and-go wire on the Screamin' Siemons' flying-wing entry—a clever touch that eliminated mid-competition wear and tear!

All remaining entries enter the pylon race.

The Connecticut Challenge

Contestants must bring:
- .25 to .35 2-stroke engine
- fuel tank and a fuel line
- utility knife
- radio and servos

The club provides:
- (1) 3x4-foot sheet of 1/4-inch foam board
- (2) wooden yardsticks
- (2) 36-inch dowels
- CA, accelerator, a wire hanger, Nyrods, strapping tape and hardware odds and ends
- razor saws and hand drills
- (2) 12x1/2x1/2-inch hardwood engine rails

CONTEST RULES

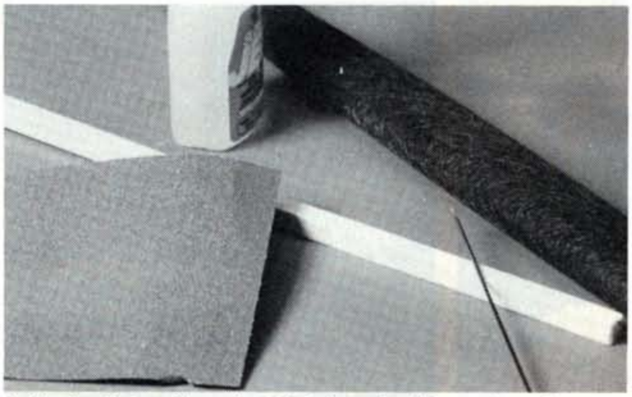
1) Materials supplied are the only materials allowed.
2) Planes are to be built by teams of two to six persons.
3) A team pilot and a team PR spokesperson must be specified at the start of the competition. (A PR person is designated to handle interviews with videocam operators.)
4) Videocam operators are cautioned that "No ideas will be shared with other teams" when documenting the event.
5) Hand drills and bits, accelerator for CA, hand saws and strapping tape must be shared if needed by another team.
6) The total number of points gained in flying competition will be deducted from the total time taken, in minutes, to design and build a design. The team with the fewest points wins the challenge.
7) A test flight is required before a given aircraft may proceed to the flying competition. Extreme caution must be taken in the test-flying portion of the competition, with hand-launches at least 100 feet out on the flying field, well upwind and removed from the spectator and pit areas.

HOW TO:

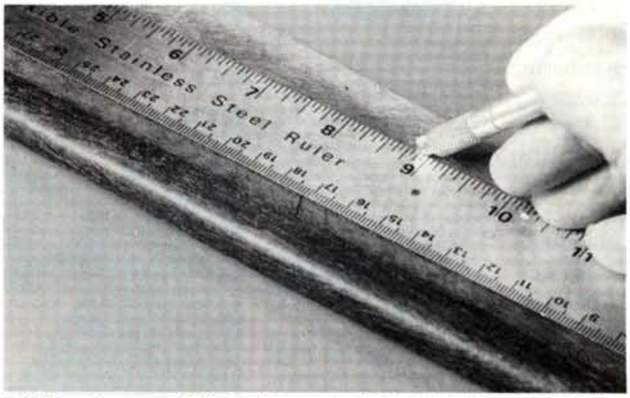
R A N D Y   R A N D O L P H

MAKE CARBON-FIBER REINFORCED PUSHRODS

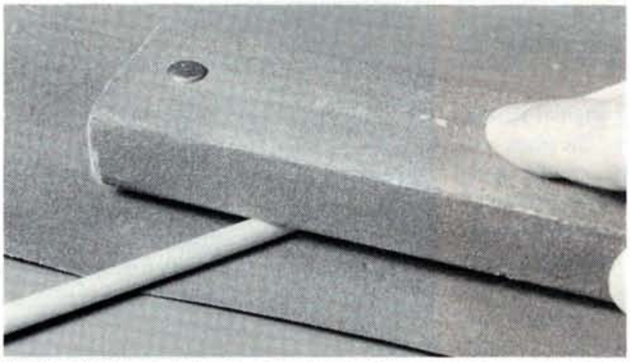
Adding carbon fiber to balsa increases its strength dramatically without adding a lot of weight. The photos show how to use carbon fiber to make strong, light pushrods.



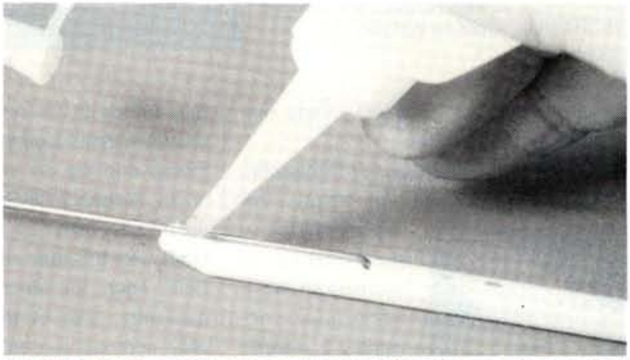
1. Here's what you'll need: .004-inch carbon-fiber mat, sandpaper, a sanding block, 1/4-inch-square balsa stock, 1/16-inch wire and CA.



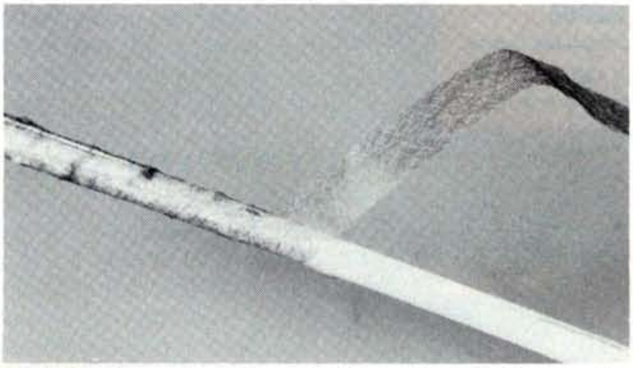
2. With a sharp razor knife and a smooth, flat straightedge, cut the carbon mat into 1/2-inch-wide strips.



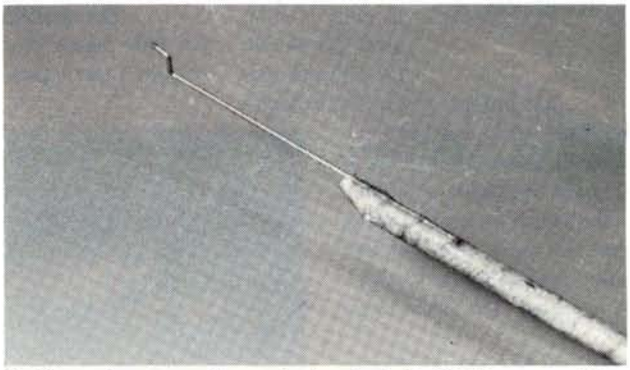
3. Place the balsa between a sheet of sandpaper and a sanding block; then, at the angle shown, use a rolling motion to sand it into a dowel.



4. Form Z-bends, or solder threaded couplers for clevises onto a length of 1/16-inch wire; then bend the other end of the wire to form a right angle. Push the bent end into the balsa 2 inches from the end, and glue it into place.



5. Starting at one end, spiral-wrap the balsa pushrod with strips of carbon fiber. Allow the fiber to overlap about 1/8 inch on each wrap. Slow-acting CA helps to hold the mat in place as you wind it.



6. After you've wrapped the pushrod, saturate it with CA or epoxy. When the glue hardens, the pushrod is ready to use. These sizes of balsa and wire are adequate for small to medium models. Heavier wire and 3/8-inch-square balsa should be used for larger models.

HOLIDAY WISH LIST

LAST YEAR'S Wish List could, more appropriately, have been called the "dream list," considering how "pricey" the items were. In line with the recent "belt-tightening" economic climate, this year, we chose items that are not only of use to all modelers, but are also quite affordable. Modelers often seem to part quite willingly with cash for radios, kits and engines; after all, these things are the essence of the hobby. But when it comes to the purchase of the practical support equipment needed by all modelers, whether they're into scale, pattern or sport flying, their "spending-mood" quickly turns a bit more reticent. Hence, we give you the perfect Wish List —to be photocopied and passed out to loved ones—especially loved ones who still have some disposable cash kicking around and/or credit cards with room left on them. Oh, yes, if your loved one won the lottery this year, we did put one item on the list just for you; you'll know which it is by its price. A merry full stocking and a happy spinning dreidel to all!

A Merry Loop And A Happy Snap To All!

ELECTRO-FILE

The MHT Products **Electro-File** is a cordless, electric, reciprocating tool with which you can cut, file, sand and shape accurately. It brings a different dimension to woodworking. This light-duty tool has a built-in, rechargeable 3.6V battery, and it comes with a charger, a variety of saws and files, and a sanding paddle. **$69.95**

FUEL PUMP AND VOLTMETER

▲ excellent stocking-stuffers from Royal

Here are two handy pieces of field equipment any modeler will find useful. Royal's new high-volume, **Self-Contained Fuel Pump** can be powered by four internally mounted "AA" alkaline cells, or it can be plugged into the 6V section of your power panel. **$22.95**

THE EXPANDED-SCALE VOLTMETER

will test 9.6V and 4.8V receiver battery packs. This unit features a built-in load (to simulate actual working conditions in your receiver battery pack) and a load feature that allows timed discharge rates (to give accurate information on operational time limits of radio battery and alert you to the presence of a bad cell). Lifetime limited warranty included. **$12.95**

ALTECH'S READY-TO-GO FIELD BOX

This all-wood, **field box** features:

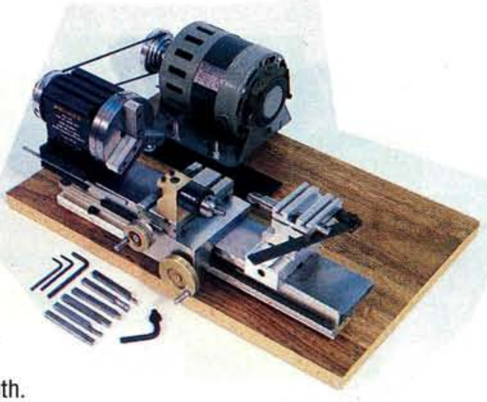
- automotive-grade paint with tough acrylic overcoat;
- adjustable cradle with foam liner;
- deep top trays and drawers big enough for an electric starter and tools, and a handy shelf with a fuel-container restraining strap;
- easy-to-transport size: 18x8x13inches (not including draw-knob and cradle). **$59.95**

DREMEL 16-INCH SCROLL SAW

This **variable-speed scroll** saw allows you to cut materials at the proper speeds—from 200 to 2,000 blade strokes per minute and anywhere in between—and cuts cleanly and accurately. The saw has a sturdy cast-iron base; a sawdust blower; a see-through blade guard; and a round, 12-inch, cast-aluminum, tilt-table. **$390**

MICRO LATHE

▲(elf's choice)



Hobby Lobby's **Taig Micro Lathe** is a tried-and-true shop tool. Associate editor Gerry Yarrish has had one since high school (18 years), and it's still going strong. The lathe comes with everything you need to turn and cut metal up to 4 1/2 inches in diameter and 9 3/4 inches in length. Included are: Taig 15-inch bed, 1/8hp motor, mounting board, three-jaw chuck, 1/4-inch Jacobs chuck, five-piece tool-bit set, lever-operated tailstock, pulley set and belt. This thing really does what it's supposed to do. It has more than 35 optional accessories, many of which cost $10 or less. **$284**

WIND METER

The hand-held Hobby Lobby **Wind Meter** reads wind speeds from 2 to 66mph. It's about 6 inches long and has two scales: 2 to 10mph and 4 to 66mph. It's great for the meteorologically minded, traffic-over-controlling, pain-in-the-neck elf. **$14**

DIGIPACE II

If you don't like to see your beloved modeler cry because of a battery-failure-induced crash, make sure an **Ace R/C Digipace** is under the tree. Think of it as a good investment; a crashed plane means allocating emergency funds to buy that desperately needed replacement. This charging and cycling system eliminates any battery-memory effect and keeps batteries in top condition. It's totally automatic, has an "auto-trickle" feature and will cycle two packs at the same time. Barrel-type connectors are included for versatility. **$159.95**

Every modeler needs a HIGH POINT in his life

Your beloved modeler's life will go much more smoothly if you put a Robart **High Point Balancer** under the tree. It doesn't matter if he's spinning props, fan impellers, wheels, spinners or anything else that whizzes around an axis at high speeds. Whatever he spins, he'll spin it much more smoothly and, more important, with greater safety if he has an ultra-precise Robart Mfg. High Point Balancer in his shop to balance it on. **$29.95**

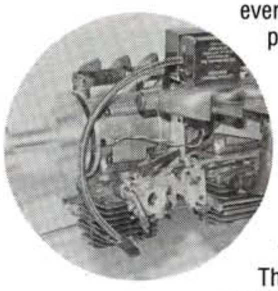
SMART CUT

▲(stocking stuffer)

This new trimming tool from Top Flite is specially designed to cut MonoKote and other plastic covering materials. It cuts quickly and easily and allows you to make virtually invisible seams. Check out the price! **$5.95**

SUPER SUPERMARINE

▲(lottery winner's choice)



This 112-inch-span **Spitfire MK XII** from Clark Industries includes almost everything—everything except paint, glue and a radio. All the items you need—molded-in panel lines, scoops, three-blade prop, air-operated scale oleo main gear, scale tail wheel and aluminum spinner—are included for the creation of a highly scale-detailed fighter. *Nothing* is left out. Even the glass cloth is supplied! Also included (to drive the Spit to its claimed 90mph mark) is the impressive Clark Gryphon 100cc, 10hp, in-line twin engine featuring scale, functioning exhaust stacks. This kit is available direct only, and its price is about $2,500, depending on the exchange rate. It's actually not a bad price considering all you get in this amazingly complete, unique kit. Contact Clark Industries. R.R. 4, Tottenham, Ontario, L0G 1W0, Canada; (416) 936-2131.

FIELD & BENCH REVIEW

MODEL AIRPLANE NEWS MAGAZINE

Of airships and flapper dresses

BYRON Ryan STA

by CHARLES FULLER

AFTER BUILDING MY Byron Sukhoi and flying it at last year's Top Gun competition, I eagerly awaited the arrival of Byron's Ryan STA. Finally, a huge box containing everything but a radio and an engine arrived at my doorstep. Needless to say, like any other crazed modeler, I opened the box quickly. The fiberglass work on the fuselage was beautiful! Nice work, Byron—so nice that part of me didn't even want to paint over it. Lots of bags were filled with miscellaneous parts, i.e., gas tanks, wheels, struts, bolts and nuts—you name it, it was there. Injection-molded foam wings and tail feathers were packed in protective cardboard sleeves.*

I glanced through the instruction manual to get an idea of what lay ahead. The 27-page booklet has 100 photos, including a cover shot of Ken Bundt, the project engineer for the Ryan STA. I spent two hours studying the instruction manual; remember, it's 27 pages of detailed, step-by-step procedures and, in addition to the photos, there are many exploded views of construction and lots of three-views for scale documentation and accuracy. There's also a huge sheet of decals and much, much more.

ENOUGH PROCRASTINATING

Time to quit studying and start building! The instructions are so complete and so comprehensive that it would serve little purpose and waste lots of space to try to repeat, or even summarize, the complete construction here. Instead, I'll share some tips that I've found helpful when I work with a kit such as this one.

I decided to sand all the fiberglass parts inside and out to ensure good adhesion of the various adhesives and primers I use. Use coarse paper on the inside and fine paper on the outside. There was one minor crack (from shipping, I guess) in the fuselage. This is quite common with glass fuselages, and it's easy to fix. First, take a piece of glass cloth that's big enough to cover the damage, then spray a light coat of contact cement over the area to be patched. Press the patch to the inside of the fuselage and over the crack. Then, saturate the cloth with thin CA. Use extra layers of glass cloth and polyester resin as needed. This simple procedure works well. Give this method a try in other areas as you reinforce formers and other high-stress areas that you feel are at risk. It's strong and fast.

I use Zap-A-Dap-A-Goo* in areas that are subject to vibration fatigue, e.g., servo rails, cowl assemblies, fuel-tank installations. It's also great for attaching lead balance weights, but don't use it on foam, or where it will come into contact with fuel.

I taped all of the three-views and exploded views on the wall for easy reference. It beats searching for them all the time, plus they stay clean! The plastic bags are numbered, so it's easy to find the right parts. The next step is to spill a cup of coffee on the instruction booklet; of course, you can omit this part if you wish but, somehow, I viewed this event as a bit of good luck. Maybe I should throw a few drops for good measure onto the three-views that I just tacked to the wall! Boy, is this fun!

A REMINDER

Please, please, please, follow the instructions! They're very well done and explicit, so take advantage. I've been building model planes for years, so I hope by now I've learned. If all else fails, you know what to do: read the instructions!

PHOTOS BY ANDY COMINOS

Chuck Fuller poses behind his Byron Ryan STA.

SPECIFICATIONS

Model name: Ryan STA
Manufacturer: Byron Originals
Type: WW II trainer
Price: $495.95
(Byron motor mount—$46)
Wingspan: 90 inches
Weight: 20 pounds, 8 ounces
Length: 66 inches
No. of channels req'd: 4
(aileron, elevator, rudder and engine)
flaps optional
Engine used: Quadra 35
Airfoil: semisymmetrical
Washout: none

Features: plywood reinforced fiberglass fuselage with glass-covered appendages. Fiberglass-cloth-covered, molded-foam wings.

Hits

- Excellent glass work
- Detailed instructions with many diagrams and exploded views.
- Flight performance is very stable and relaxing
- Scale realism on the ground and in the air

Misses

- The diagrams and exploded-view sheets weren't well organized in the kit. To avoid confusion, they should all be put into one packet.

THE GOLDEN-AGE UNDERCARRIAGE

Installing the landing-gear legs according to the instructions presented no problems. Installing the wheels and wheel-pants/strut-fairing assembly, however, was a bit more challenging. I had to read and re-read the instructions to do it correctly, but the extra study time paid off. It will help a lot if you first assemble the landing-gear/fairing assemblies during a practice run before you glue and bolt everything together. This process is a major confidence-builder and a stress-reducer, and I highly recommend it. Paying special attention to the side-view drawing and the exploded view really helps to answer questions here. I had to bend the metal fittings slightly.

WING TIPS

I checked the wing fit against the fiberglass wing roots, which are molded as part of the fuselage, and everything seemed correct. After completing the wing installation, I found the results truly satisfying. Once again, just follow the instructions religiously, and you'll have no problems. I ordered some Dan Parsons* .6-ounce glass cloth to cover the wings and other flying surfaces. It's great, and it comes with complete, easy directions. The package Dan puts together would be great for the guy who is glassing wings for the first time.

When you're working on the flying surfaces, lay a piece of foam carpet padding on your work table. It helps to prevent the foam from becoming dented and nicked. I found a small screwdriver under my wing during the covering process. I hate to see a grown man cry, especially when it's me!

THE HEART OF THE MODEL

Because the fuselage incorporates the wing center section and roots, it's the structural "heart" of the model. Since there are only a few main formers, a firewall former, three cockpit formers, a tail-wheel former and wing-root covers, it's a good idea to spend some extra time reinforcing these parts with the fiberglass method that I mentioned earlier. Apply this reinforcement where the formers join to the fuselage inside wall. All the die-cut plywood formers fit pretty well, and building the fuselage goes quickly.

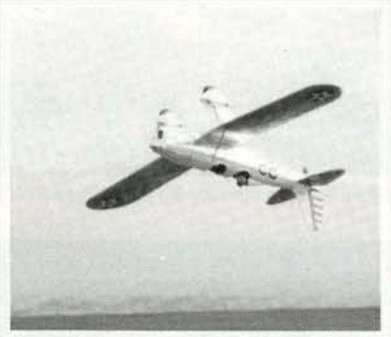
A WORD ON POWER

I installed a Quadra* 35, and it really seems to be

FLIGHT PERFORMANCE

We have a beautiful flying field at Questa College in San Luis Obispo, CA. We call ourselves the S.L.O. Flyers. It was a beautiful Saturday morning. Having checked all the controls, the engine and the radio range, I was out of excuses. The moment of truth had arrived. I said a prayer while I held the transmitter and my breath. I taxied the Ryan onto the runway with as much scale-like finesse as my flying ability would allow. Just in case of a mishap—every modeler knows how risky first flights can be—I wanted my elegant Ryan STA to be remembered with style and grace.

• Takeoff and landing



After hitting the center line of the runway, I let the Ryan idle at the end of the strip for a minute—just for dramatic effect. I still hadn't exhaled. I slowly advanced the throttle and, oops, my rudder hand must have frozen, for the Ryan veered off to the left sharply. OK, one more time: line up again and exhale and inhale (how that simple organic process can refresh one's memory!). Remembering to feed in right rudder while advancing the throttle quickly did the trick. Straight down the runway was followed by an easy liftoff—almost a hands-off fly-out. This is a gentle aircraft. While slow, final-approach speeds are very stable with this model and landings are easy to execute with no flap, three-point landings are done better with flaps deployed. With scale landing gear like the tall units found on the STA, it's easy to drag a wing tip or otherwise get "crossed-up" during landing roll-out. Slower, three-point, flaps-down landings help keep this minor problem to a minimum. The Ryan is much better behaved if full up-elevator is fed in and held after touchdown. Otherwise, the Byron Ryan is a pussycat during takeoffs and landings.

• High-speed performance

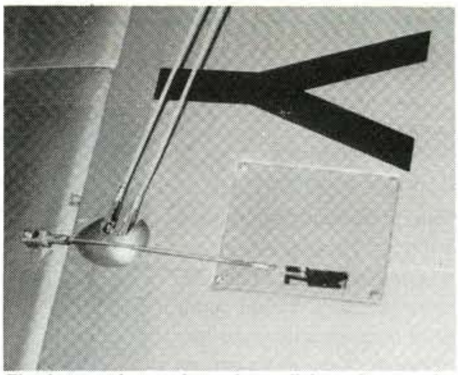
The Ryan reacts very predictably at full-throttle settings, and it tracks smoothly through turns. The combination of all those wires, wheel fairing and pants introduces sufficient drag to help keep this model flying at more realistic speeds than many scale models I've watched fly in the past. The STA has a majestic, scale-like demeanor in the air, and this makes it quite fulfilling and exciting to fly. And it doesn't have any quirky flight characteristics often associated with scale subjects. The Ryan acts much like a big sport plane, but with incredible aesthetic appeal in the air.

• Low-speed performance

During low-speed flight, the pilot must kept in mind that this is a high-drag design. Not that the model has questionable slow-flight characteristics—quite the contrary. The wing has very favorable characteristics at low speeds with no tendency to suddenly tip stall. It's just that air speed is lost at a rapid rate, especially with the flaps deployed, and that can be dangerous particularly when turning downwind. The simple procedure here—to ensure that speeds don't get too slow—is to keep the engine speed at, or a bit above, the high idle mark (2,500 to 3,500rpm) to counter the drag of the Ryan. Once again, this is even more important to keep in mind when the drag-inducing flaps are down.

• Aerobatics

In line with the generally smooth flight characteristics of the Byron Ryan, its aerobatic capabilities, while obviously not competitive, are very graceful and, once again, scale-like in nature. The combination of the disk effect of the idling big prop and the Ryan's overall drag helps to keep down-line speeds well under control. Snap entries and exits are predictable and a beautiful sight to witness. Inverted flight is so relaxing, and it requires only a moderate amount of down-elevator input. Entire flights could be done upside-down without undue stress on the seasoned pilot. Adding smoke to the aerobatic display of this polished-aluminum beauty makes flying it absolutely dream-like.



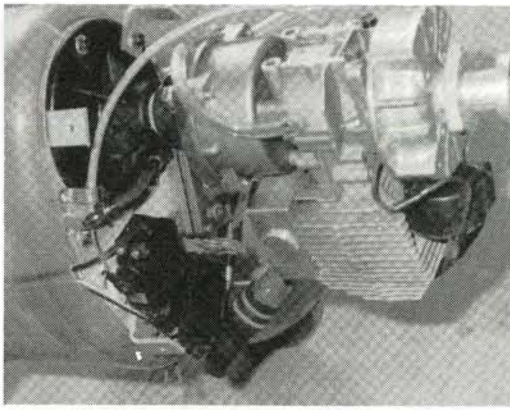
The lower wing surface shows flying-wire attachment points and aileron servo installation. Dan Parsons' glass cloth and epoxy covering system worked well on the wing.

a perfect match for the Ryan in terms of power and fit. Plus, it was a snap to install using the optional Byron radial mount. Most important, however, nothing makes smoke like an ignition engine!

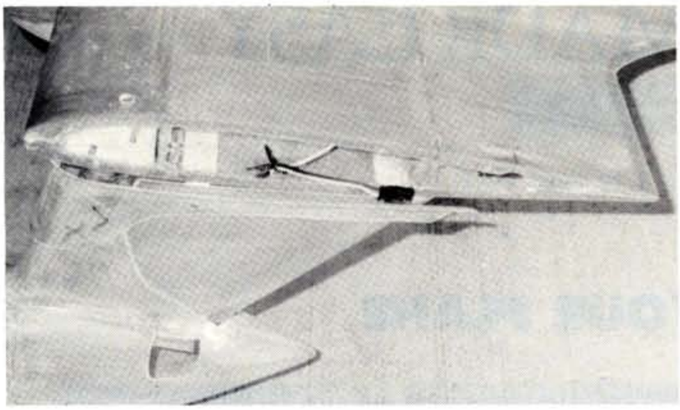
THAT NATURAL GLINT

I've been creating polished-aluminum finishes for a long time, so here are a few tips. I use chrome trim MonoKote* that's cut to approximately scale panel sizes. I lay these panels out on any smooth surface that doesn't have compound curves. Overlap each panel by about $^3/_{32}$ inch. Use aluminum duct tape (available at all hardware stores) over those difficult-to-cover compound curves. Practice with small pieces, and work away from the middle to the outer edges. A piece of soft balsa is a good burnishing tool to use on the tape. When the duct tape breaks or wrinkles, cut it with a sharp blade, and start with a new piece. A small rubber squeegee can be used to burnish the MonoKote. With a little practice, you'll be well-rewarded. Remember, if you select that polished, aluminum-like finish, be sure to wear your dark glasses and get ready for remarks like, "Wow! Beautiful!" and "How did you do that?"; you can tell 'em, cause you know how!

I made the rivet marks with nails of different sizes. On this one, I used $^3/_{32}$ inch mostly.



The optional Byron motor mount for the Quadra 35 is well worth the extra cost. Also shown is the throttle linkage with servo. The servo at the bottom actuates the B&B* smoke system.



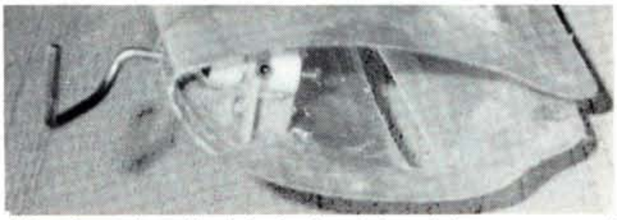
Take your time working out the fit of the three parts of the landing-gear fairing and pants. The results are worth the extra time. Plywood landing-gear mounts are visible at the wing's leading edge.

Sometimes I take an abrasive bathroom cleanser and knock the shine off on the trim MonoKote before removing the backing. Also, you could thin some black paint—a few drops of black to a lot of thinner—and carefully wash the finished product with it to achieve a little more dirt-in-the-cracks realism.

I've been using weed-trimmer monofilament nylon line or fishing line (120- to 150-pound test) to make flying wires. I use Du-Bro* Quick Links on the ends, open up the threaded portion enough to get the nylon into the opening, crimp it shut and wick-in thin CA to hold it. The nylon/quick-link assembly must be about a 1/2 inch shorter than its intended span and stretched into place. This system has really worked out very well. The kit does have all the necessary materials so that you can make the flying wires with threaded steel wire, which also works well.

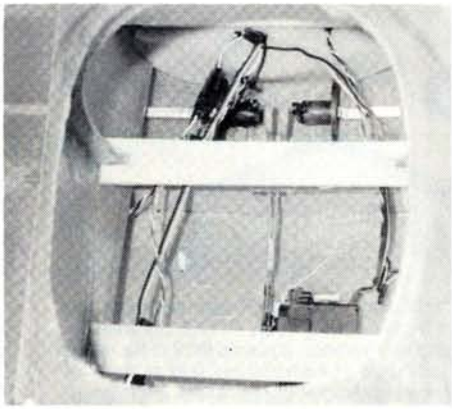
THE PERSONAL TOUCH

For me, part of the excitement of building a scale model is to create a little extra realism, i.e., make a scale-looking propeller or enhance the cockpit detail with knobs, radios and throttle controls. You'll be glad you did. I made a few minor changes to match my documentation, which is a Menasco version, and I used documentation from Scale Model Research*. The kit also shows cowl detail and includes exhaust parts. I had to bend the tail-wheel bracket back about 30 degrees, and I changed the shape of the bottom of the wheel pants. These were very minor changes, but I had to change something, right? I hope you enjoy this project as much as I did. Please follow the directions carefully, and you'll be well rewarded.

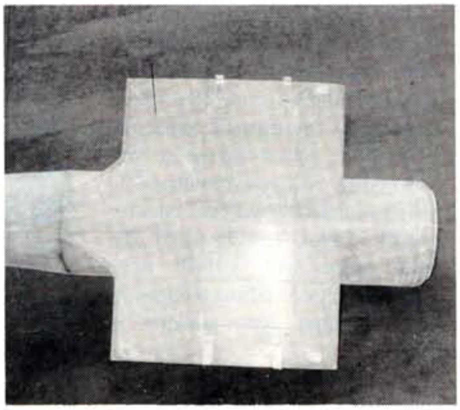


After a thorough sanding, lots of resin and glass-cloth scraps were used to reinforce the tail-wheel bracket installation. The tail-wheel wire was bent back 20 degrees to match the three-view drawing.

**Here are the addresses of the companies mentioned in this article:*
Byron Originals, *P.O. Box 279, Ida Grove, IA 51445.*
Zap-a-dap-a-goo; *distributed by Frank Tiano Enterprises, 15300 Estancia Ln., W. Palm Beach, FL 33414; Robart Mfg., P.O. Box 1247, St. Charles, IL 60174; House of Balsa Inc., 10101 Yucca Rd., Adelanto, CA 92301.*
Dan Parsons, *11809 Fulmer Dr. N.E., Albuquerque, NM 87111.*
Quadra-Aerrow Inc., *P.O. Box 183, Perth, Ontario, Canada K7H 3E3.*
MonoKote/Great Planes Model Distributors, *P.O. Box 9021, Champaign, IL 61826.*
Du-Bro Products, *480 Bonner Rd., Wauconda, IL 60084.*
Scale Model Research, *2334 Ticonderoga Way, Costa Mesa, CA 92626.*
B & B Specialties, *14234 Cleveland Rd., Granger, IN 46530.* ■

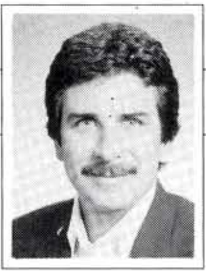


Flap-linkage detail and plywood floor supports are shown. All formers are glued in with fiberglass-cloth reinforcements after the contact points on the inside surface of the fuselage have been sanded.



Integral fuselage and wing center section give the Ryan much of its strength. Note attachment points at wing roots for the landing-gear and wheel-strut covers.

AEROBATICS MADE EASY



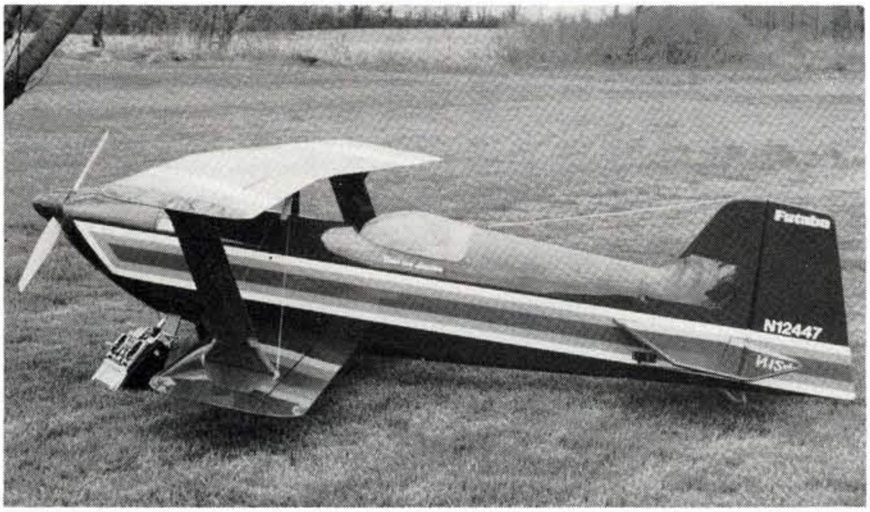
DAVID VON LINSOWE

CHOOSING YOUR PLANE

Editor's note: guest columnist David von Linsowe has been modeling for more than 30 years—starting with free flight and control line—and has been competing in pattern flying for the past 20 years.

Dave is the U.S. National Champion in pattern, and he placed third at the recent World Championships in Australia. His latest pattern design, the USA Star, lived up to his assertion that "bigger flies better" at the recent NATS. With 1,145 square inches of wing area, it's the biggest pattern airplane on the circuit.

David is the owner of Performance Products Unlimited, developer of the Vibra-Damp soft engine mount.



This biplane is the "Courtesan"—a T.O.C., 35-percent-scale model of Henry Haigh's full-size unlimited aerobatic contender. Both the original and the model have retractable landing gear. The top wing and stab have been lowered to reduce roll and pitch coupling.

QUITE OFTEN, I'M asked, "What airplane should I get?"—simple enough question, but the answer is not so easy. With aerobatic aircraft, the selection can be very critical. Unlike other types of flying, aerobatics uses the full flight envelope of the design. A good aerobatic design will easily fly at its aerodynamic limits.

WHAT KIND OF PERFORMANCE?

Keep in mind that every design is a compromise. When looking for your next world-championship design or the hot-dog special that will blow the socks off everyone at the local field, think about how you want the airplane to fly. Think about how you want it to handle the wind. Do you want something that is responsive and wild or smooth and graceful? How about unlimited vertical performance? High speed on the deck, 15-second slow rolls or vertical down-snaps at less than 30 feet? These are a few of the questions you need to ask yourself before the balsa chips fly.

CHOOSING THE DESIGN

How do you determine which design will perform to your expectations before you buy it? Check out the local flying field; see how an aircraft you may be interested in handles. Be careful with this one; fliers often don't have their airplanes set up properly. Look out for gaps between the control surfaces, binding control surfaces, servos that respond slowly, misalignment in construction, improper CG location and incorrect trim. These things can make a great design fly like a worm. (See also "Watch for ..." next page)

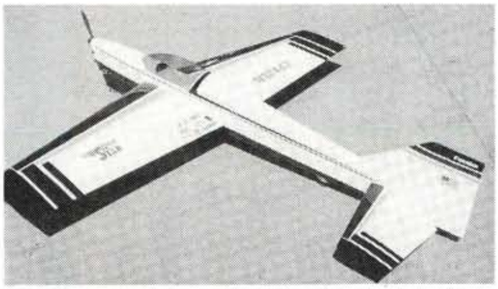
KEY DESIGN ELEMENTS

Remember that every airplane is governed by the laws of physics and flies in a particular way because of its design. A Piper Cub will not fly the FAI pattern to perfection. Even before you see your next dream airplane fly, you can make predictions about its performance if you know how to analyze its design.

For an aerobatic aircraft, a symmetrical airfoil is almost a must. A thick, blunt airfoil will reduce top speed and inhibit snap-rolls. Variations from a symmetrical airfoil can be used to your advantage for hot-dog flying. A semisymmetrical to flat-bottom airfoil may be better for outside snaps and inverted flat spins since such airfoils have greater inverted stalling tendencies when enough down-elevator is used

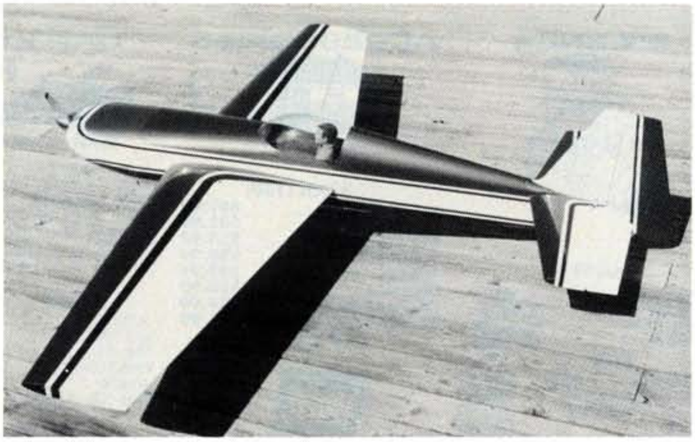
If you prefer knife-edge flight, you need a larger forward fuselage side area. Biplanes will knife-edge with little rudder input, but generally, will have a severe roll and pitch coupled with rudder input. Lowering the top wing and stab will help with these problems.

The wing-planform taper will affect how an airplane handles in the roll axis. More taper will generally improve roll response and reduce wing-tip "bobbles" in turbulence. A small tip can cause tip-stalling problems or improve snap-roll characteristics. A long tail moment will smooth out pitch and yaw characteristics, but could lead to difficulties with snap rolls.



This is my "USA Star." With its 77-inch wingspan and 1,145 square inches of wing area, it leads the trend toward larger pattern airplanes. It placed third at the recent World Championships in Australia and first at the AMA Nationals. It is a capable hot-dogger and is fun to sport-fly.

If you're looking for a hot-dog sport airplane, don't overlook pattern designs. These airplanes have been optimized to fly perfectly. If built light, they also have a very large flight envelope. Increase the control throws, and they'll be capable of any wild maneuver you can dream up. If you have a choice, I recommend the new 1.20 designs; remember that bigger flies better. Built as a fixed-gear tail-dragger with wheel pants, it will be a sleek, sexy sport machine that will give you many hours of fun.



This is my latest T.O.C. project—a 35-percent-scale model of Patty Wagstaff's Extra 260. With a 102-inch wingspan, it is in keeping with the principle that bigger flies better. The highly tapered wings help in gusty, turbulent air. It will be kitted by Precision Built Models of Spring Branch, TX.

LOOKS ARE IMPORTANT

It's very important to consider how the airplane looks to you. This may seem silly, but if you're not happy with how it looks, you won't put much effort into reaching its potential. It probably won't last long, either. From an unscientific position, there's a lot of truth to the saying, "If it looks good it will fly good."

Once you've decided on and built the airplane of your dreams, here are a few hints to keep it flying well:

• Always seal the aileron and elevator hinge lines.
• Double-check that the ailerons are moving in the right direction relative to the stick movement.
• Moving the CG backward will lower the stall speed to some degree while increasing elevator effectiveness and thus making stalls and spins easier.
• Balance the complete airplane laterally (side to side).
•Always go for maximum rudder throw: 35 to 45 degrees is good (tame it around center with exponential).
• Watch how others fly, and learn from their mistakes.

Hope to see you at the flying field soon; I'm looking forward to having my socks blown off!

WATCH FOR ...

When watching a possible future project as it flies, check these: control authority, control coupling, control damp ing,stall speed and power-to-weight ratio. I'll explain what I mean.

• **Control authority** is the ability to maneuver fast enough in any axis at any flight speed that may be necessary for the type of flying you intend to do. Enlarging control-surface areas will improve control authority. Moving the CG aft will increase elevator and rudder effectiveness.

• **Control couple.** When one control input affects more than one axis of motion, there is a control coupling. Rudder is the biggest culprit here. Typically, sport designs roll and pitch with the application of rudder.

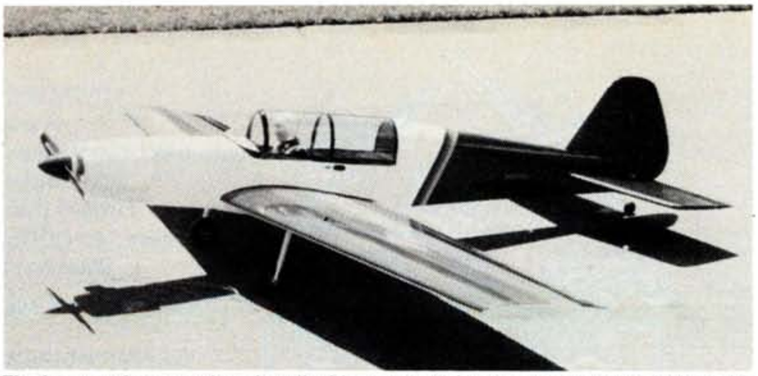
• **Proverse roll coupling** is when the plane rolls in the direction of rudder input. This is a case of having too much wing dihedral. A roll that's opposite of rudder input is adverse roll coupling, and it's caused by too little dihedral. Pitch coupling is usually toward the bottom of the aircraft and is assumed to be the result of the stab's being too high. Ideally, the aircraft should yaw only with rudder input. This will greatly simplify slow rolls, point rolls and stall turns. The newer computer radios with control mixing can go a long way to correct this.

• **Control damping** is the rate at which an aircraft will stop oscillating in all axes. In the roll axis, the absence of damping is shown by the dropping of a wing tip or dancing in turbulence. Damping in the pitch axis should enable an aircraft to be flown hands-off from horizon to horizon at a constant altitude. In yaw axis, an aircraft shouldn't fishtail after rudder input.

• **Stall speed** is directly related to wing loading and airfoil. Stall speed will affect how readily an aircraft can be made to snap-roll. The lighter the wing loading, the more difficult an aircraft will be to snap-roll. Sharp leading-edge airfoils are frequently used to help with snaps. Planes with lighter wing loadings will fly through the maneuvers more easily because less drag is developed during high-G maneuvers. Aerobatic aircraft range from 17 ounces/square foot to 28 ounces/square foot. I've found that a range of 20 ounces/square foot to 24 ounces/square foot seems to be the best compromise.

• **Power-to-weight ratio** is critical for good vertical performance. If we know the size of an aircraft, we can determine what its finished weight should be to obtain a 20- to 24-ounce/square-foot wing loading. We can reverse this to determine how big the airplane should be for the engine we want to use. My experience has been that larger airplanes fly better as long as their wing loading and power-to-weight ratios are within the proper limits.

HOW TO Build Lighter Foam Wings and increase performance



The foam-cutting procedure described here removed over a pound of weight from this airplane. The improved performance makes it worth the effort!

by ROLLY SINGSON

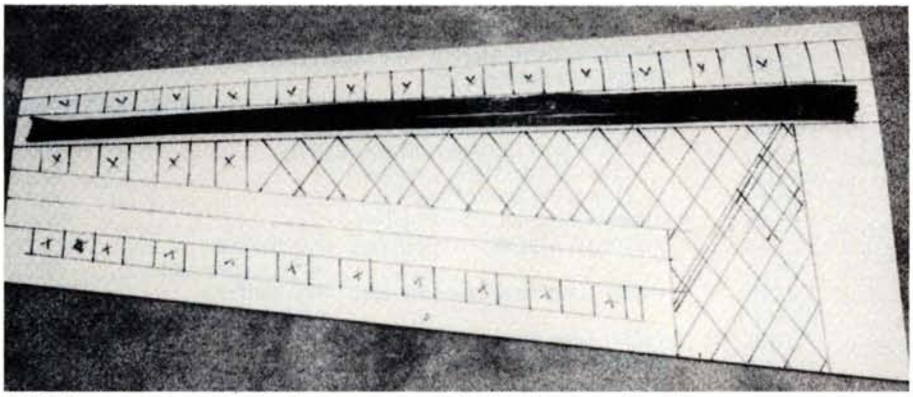
IF YOU'RE BUILDING planes with foam wings, you can use this lightening technique to enhance your model's performance.

I used this procedure on one of two, identical 74-inch wings—wing area 950 square inches—for my 1.20-size sport/pattern airplane. The conventional, solid, foam-core wing weighed 8 ounces more than the one I lightened. If you also lighten other areas of the aircraft in addition to the wing, weight reduction could be up to a pound.

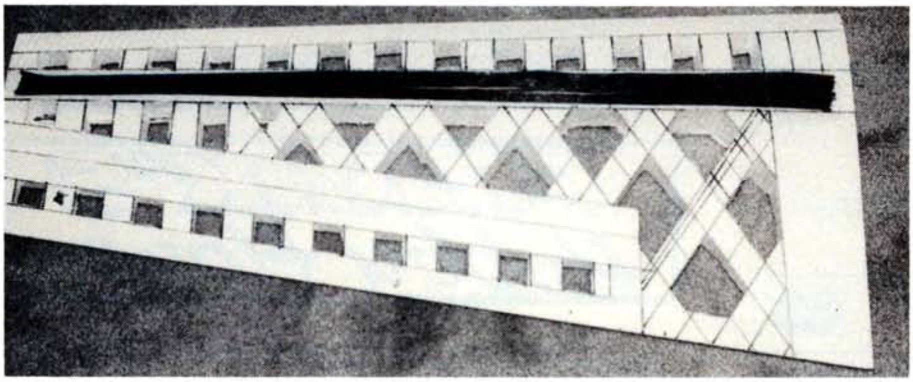
I'll concentrate on building the wing, although the methods presented here may be applied to the construction of any other part of the aircraft.

PREPARING THE CORE

Because foam melts when it's cut with a hot wire, a foam-core always has some "foam hair" clinging to it, and it may also have some bumps. Remove these by lightly sanding the wing surface with a block sander. (I recommend one that's at least 18 inches long with 120- to 180-grit sandpaper.) Then, brush or vacuum the surface to remove as much of the foam dust as possible.



This is how your wing will look after you have marked off the "honeycomb" pattern.



The honeycomb has been cut. Note the solid foam along the spar and hinge lines.

Find the spar center line and, with a felt-tip pen, draw a line from the root to the tip about an inch on either side of the spar line. Use a straightedge for accuracy. Do this on both the top and bottom surfaces of the wing, and make sure that the ends of the lines align with each other at the root and tip. Do the same thing for the control-surface hinge lines (see photos).

Also, draw lines approximately 1 inch from the leading, trailing and tip edges. Next, draw a line, parallel with the root chord, 2 to 4 inches from the root edge, depending on the size of wing. As a rule of thumb, I draw a line 2 inches away from the root edge for a 60-inch wing, 3 inches for 72-inch wing, 4 inches for 84-inch wing.

Next, I'll focus on the areas between the leading-edge line and the front spar line, the aft spar line and the front hinge line, the aft hinge line and the trailing-edge line and the tip line and the root lines.

Draw diagonal and perpendicular lines, 1/2- to 1 1/4-inches apart, in these sections to create an "egg-crate" effect. Mark x's on the areas that need to be removed (see photos). If you're building a wing that will have landing-gear blocks or retracts installed, mark off these areas and be sure to leave enough foam in them to accommodate the mounting blocks and gear wells.

CARBON FIBER

Next, lay up graphite or carbon fiber on the top and bottom spar areas along the wing panel's entire length. (I used carbon-fiber tow, but carbon-fiber tape can also be used.) For added insurance on bigger wings, glue a 1/4- to 1/2-inch strip of carbon fiber on the forward hinge line. The fiber must run from root to tip.

REMOVING EXCESS FOAM

There are several ways to remove "unwanted" foam from the wing.

• **Piano wire**. I use a .020-diameter piano wire that has been bent into a rectangular shape and attached to a wooden wand. It is heated by current from a variable transformer. It cuts well since the wire temperature is easy to regulate. Do not try to build such a device without expert advice! Consult with a pro like Jim Graham at R/C City.*

• **Hacksaw blade**. A hacksaw blade with one tip pointed (to ease the initial piercing) also removes foam. Keep your strokes as perpendicular to the surface as possible.

• **Soldering gun**. You can also use a soldering gun with a modified, homemade tip. I use a solid copper wire that's shaped like the original soldering tip, but long enough to extend at least 2 inches beyond the wing's thickest part. Depending on the gun's wattage and the wire's thickness and length, you may need to turn the gun on and off several times while using it so that it doesn't get too hot.

WING SKINS

Prepare your wing skins as you normally do. Here are a few pointers that may help:

• **Weigh the sheets**. If possible, weigh each sheet before joining so that you can evenly distribute the weight between both wing panels.

• **Sand joints**. On a clean, flat surface (I put a full-length mirror on my workbench), sand the skin joints and surfaces to an almost ready-to-cover finish. This saves a lot of time in the finishing stage, and helps avoid uneven sanding when the skin is attached to the foam wing. Remove all sanding dust from the skins.

WING SKIN INSTALLATION

I use slow-cure epoxy (five parts resin to one part hardener). This gives me time to position the sheeting on the foam before I weigh it down, and it eliminates the possibility of building a warped wing (so long as the cradle sits on a flat surface). Slow-cure epoxy also generates less heat during the curing process; heat can cause sheeting to de-bond from the foam. Once cured, the wing panels are ready for final assembly and finishing.

The benefits of this foam-wing lightening procedure are reaped on the flying field. When you want outstanding vertical capability from your aerobatic model, or a few extra ounces of detail on that "full-house" scale warbird, removing excess weight is the way to go.

**Here's the address of the company mentioned in this article:*
***R/C City**, 215 Big Springs Ave., Tullahoma, TN 37388; (615) 455-0735.* ■

GOLDEN AGE OF R/C

HAL DeBOLT

AUTOGIRO FROM THE '70S

The original autogiro ready to become airborne. It's powered by a K&B .40 and controlled by a Pro-Line radio.

A LETTER from Marvin Leazenby of Anderson, IN, leads us off this time. Marvin lives just 25 miles north of the new AMA Muncie facility which, he says, is shaping into an almost unbelievably fine modeling center. Also, he praises his '79 Kraft system, which continues to serve him well. He's obviously a Phil Kraft fan!

We're all aware of the Robart incidence checker. By attaching the module from a carpenter's "smart level," Marvin made it more useful and precise.

SOMETHING DIFFERENT

When was the last time you saw an R/C autogiro? One photo shows us Marvin's autogiro, which was built from a feature article in the September '77 issue of *Model Airplane News* (plan no. FSP 09773). This one isn't likely to win any beauty contests, nor will an Ugly Stik, yet both give rewarding performances. Powered by an O.S. 40 FP, Marv's giro is more than ample. He says this "different way" to fly raises eyebrows at the field. He claims that once he was used to its capabilities, it was a ball to fly!

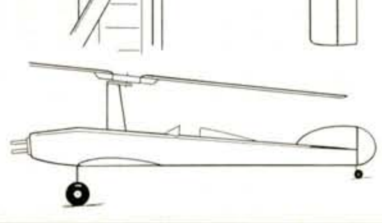
To take off with an autogiro, first put the rotor into motion. A simple, effective way to do this is to flick it by hand. The giro, however, must run along the ground a little before the rotor will reach full speed. Even then, liftoff comes within about a quarter of the takeoff run of an average sport plane. The last of the full-scale autogiros had a "jump-off" feature. As takeoff started, engine power could be engaged to bring the rotor up to speed .

Marvin simulates this jump-off feature by adding a spinner nut to the rotor shaft. He also adds a starter cone to his cordless hand drill. Using the drill as a starter, he easily brings the rotor up to speed. Once a giro is moving, rotation is automatic.

DESIGN BASICS

Marv's report tweaks my memory of an intensive period spent finishing the design of the *Model Airplane News* autogiro. The year of this project, '77, doesn't make it exactly old-time R/C, but an account of its successful first flight fits the scope of this column. Before getting into details, I'll say that in the period immediately following the publication of the original article, I had several reports (including foreign ones) of success with the giros. Everyone was happy with this excitingly different way to fly R/C.

R/C AUTOGIRO
developed by deBolt Radio Control



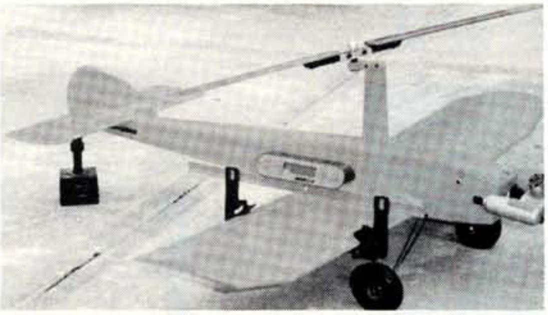
Wingspan: 48 inches
Wing area: 400 square inches
Rotor area: 100 square inches
Length: 42 inches
Power: .40 engine
Flying weight: 4½ pounds
Radio: 4-channel

Three-views of the first successful R/C autogiro (Model Airplane News plan no. FSP 09773).

An autogiro can buzz around the field at a good clip and can do what your R/C plane can't. For example, it can jump into the air much more quickly and climb nearly vertically; then, while cruising, it can slow down and hover and then return easily to cruise speed. What's more, an autogiro has the same controls as an airplane and they're used in a similar manner. Beyond that, nearly vertical landings with no roll-out are surely different!

When I contemplated designing an autogiro, my research turned up plenty of descriptions of what they were and how they flew, but I couldn't find any engineering data. As Civera had originally done, I delved into the concept from scratch. Even with knowledge of aerodynamics, the principles involved in designing a rotating wing had to be learned the hard way—by trial and error. Recalling the crashes, broken rotors, etc., encoun-

(Continued on page 66)



Marvin Leazenby's modern version of the Model Airplane News deBolt autogiro. Note the starter spinner nut on the rotor axis.

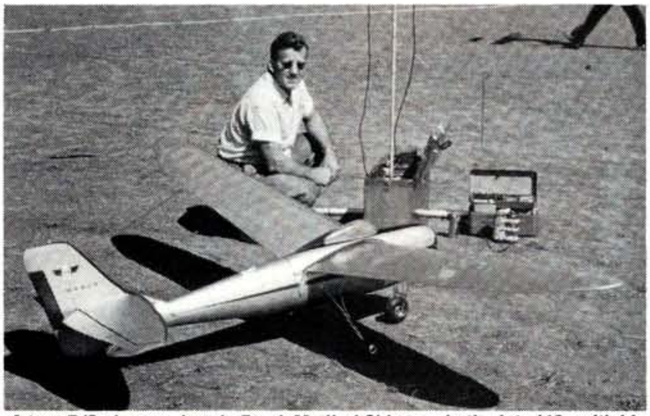
tered in the process, I wonder why I ever attempted it! But, like all else that's carried out to success, the joy of seeing results is certainly worth it!

Basically, once you understand the principle, designing an autogiro isn't much different from designing an airplane. When you realize that you're actually dealing with a circular wing that's the area of the rotor's disk, and not just the blades themselves, much of the mystery disappears. For example, if the lift is produced by a circular wing (rotor disk), the center of lift (C/L) isn't the rotor's axis. Instead, the C/L is forward of the pivot point, and that has great bearing on the craft's balance. Also, flight speed definitely affects rotor lift distribution. Owing to air speed, the forward moving blade sees a faster air flow and thus develops more lift than the retreating blade. With a rigid rotor, the C/L would not only be in front of the axis, but it would also be off to one side. In fact, rotor lift varies from one point on the circumference to another.

The remedy for this malady is articulation or "flapping wings." The blades are hinged so that at a point where lift is above normal on one blade, it causes that blade to assume some dihedral. The dihedral effect equalizes the lift with that of the opposite blade, and this keeps the C/L at a central point. Watching an autogiro rotor in action can be fascinating. They sure do flap their way around the circle of rotation! Learning these principles and applying them to a flying model was my major task, though much more was involved. I was quite frustrated before all the mysteries had been solved and the exciting performance of an autogiro had become reality.

With the anxiety connected to a radical new design, the first takeoff began. Much before expected, the giro was airborne and some much-needed lateral trim was added. This straightened its flight path (though more rotor-blade articulation would be needed). Soon, it was obviously prudent to turn the giro toward home. The return started neatly, but about halfway through, the blades began "thrashing" (oscillating) madly, and this led to a considerable loss of speed. The model fell like a wounded duck! Thus began a series of similar experiences and the learning that eventually led to the solution of the mysteries. Fortunately, because of its sturdy landing gear and slow speed, most crashes didn't involve excessive damage.

At last, after more than a year, I finally got it right. It was a windy day. The giro immediately jumped off into the wind, then climbed vertically to a comfortable altitude. After a couple of buzz-around-the-field laps, it hovered. In the wind, I noted that when the engine was throttled back to below hover power, the giro slowly descended vertically. I enjoyed several vertical let-downs to touch-and-go's, just like a helicopter! Then, I added more buzzing, hovering and a loop or two. For the climax, I flew it upwind a respectable distance and went into the hover mode. Then, I just stood and watched the wind carry the hovering giro to the far end of the field! Naturally, a vertical landing followed. I went home that day assured that my quest had been accomplished in first-class fashion. I then published my findings, so enabling others to enjoy this different way to fly R/C.



A true R/C pioneer, here's Frank Madl of Chicago, in the late '40s with his much-modified Custom Cavalier. Note the large ground-based transmitter that's weighted down with its many required batteries.

WHO'S PERFECT?

Otherwise, I stand corrected: in the August '92 issue, I describe some home-built reed systems that Stan Vanna was involved with during the '50s. One photo shows a transmitter that Stan said had been used with his unusual 6-channel receiver. I *understood* this was also home-built; its appearance didn't ring a "commercial bell" with me.

That issue was hardly off the press when Ed Rutherford, an avid OT radio collector from Tucson, AZ, called to say that he was holding an identical transmitter in his hand! I've had very little information about the OT "C-G" equipment built in Albuquerque, NM, so that could explain my "slip." Ed explained that the transmitter is actually a C-G model T-8 used with 8-channel reeds. Stan must have found it convenient to use the T-8 with his 6-channel receiver. Building the receiver was effort enough if you already had a useable transmitter!

So again I ask: can anyone provide any information on C-G equipment? I know others would like to hear about it.

I should also say that Ed Rutherford has a collection of over 200 OT systems and he enjoys sharing it. If anyone who's interested is out his way, do get in touch with him!

Space is gone once again! This was the autogiro month. I'll get back to more conventional things next time. Meanwhile, remember that this is *your* OT R/C place!

4-STROKE SCALE FLY-IN

(Continued from page 71)

WINNERS

Pilots' choice
1 Forrest Edwards .... Polikarpov PO-2 biplane
2 Dave Lovitt .... Northrop Gamma 2B

Most realistic flight
1 Forest Edwards .... Polikarpov PO-2 biplane
2 Bud Davis .... Piper L-4 Grasshopper

Best mechanical achievement
1 Forest Edwards .... Polikarpov PO-2 biplane
2 Jerry Nelson .... Nelson AA1

Best civilian
1 Dave Lovitt .... Northrop Gamma 2B
2 Walt Price .... Ercoupe

Best military
1 Forrest Edwards .... Polikarpov PO-2 biplane
2 Bud Davis .... Piper L-4 Grasshopper

Best single-engine sound
1 Forrest Edwards .... Polikarpov PO-2 biplane
2 Bud Davis .... Piper L-4 Grasshopper

Best twin-engine sound
1 Don Cress..................... North American P-82
2 Monty Welch .... Lockheed P-38

Best static only
1 Dennis Lupcho .... Travelair Mystery Ship
2 Gary Parker................... Curtiss Jenny

Best overall
1 Forrest Edwards .... Polikarpov PO-2 biplane

Scale Sound Judging

by JERRY NELSON

The most difficult task for the judges was the judging of the sound. Two items were considered—realistic cadence and realistic pitch/tone.

Our judges' manual describes cadence and pitch as follows:

"Cadence is the number of firing impulses per minute. A one-cylinder 4-stroke at 8,000rpm makes 4,000 exhaust notes per minute. A 12-cylinder P-51 at 3,000rpm (maximum takeoff rpm) makes 18,000 notes per minute. No matter how throaty the note, the single-cylinder model engine will probably sound better in a Cub trying to imitate four cylinders at 2,300rpm than a 12-cylinder Merlin. A five-cylinder radial at 7,500rpm would be right to simulate the cadence of a full-size 14- or 18-cylinder radial at 2,800rpm. Generally, the models should compromise their cadence slightly lower than scale, because their pitch will be higher, and the human ear and/or brain tends to equate a higher pitch sound with higher speed.

"Pitch is how high or low the noise frequency of the exhaust note is. This is the difficult area for modelers in attempting to replicate the big engines. Generally, a long exhaust pipe will lower the effective pitch of the exhaust and enhance its realism. Use your best judgment as to how realistic the exhaust pitch sounds. The auditory sensory input is a large part of the sensation of experiencing the performance of a real air-

Forrest Edwards of Grass Valley, CA, won top honors with this scratch-built Polikarpov PO-2. The 30-pound bipe has a wingspan of 9 feet 6 inches and was built from the builder's own plans.

Saturday's registration included 32 flying aircraft and a very large static display. Entries ranged from Jeff Weiss's 40-inch-wingspan P-47 scratch-built from Ziroli plans to Forrest Edwards' spectacular Polikarpov PO-2 biplane powered by his own scratch-built, 5.7ci, supercharged, 5-cylinder radial engine. With the great weather, outstanding models and the great flying, the weekend provided a great time for competitors and spectators.

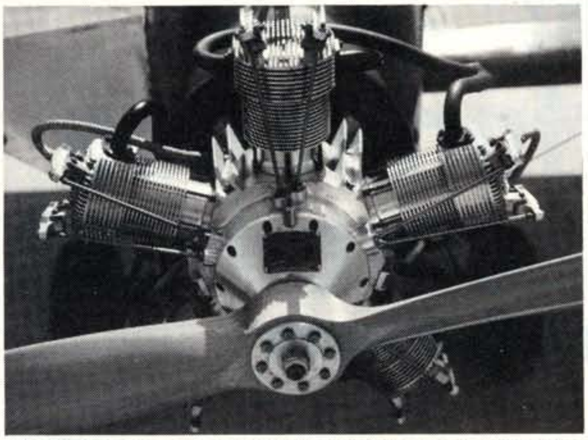
JUDGING

The static rules were very simple. Two teams of two judges each (who had a general background of full-scale aircraft) were selected. The judges were Jerry Nelson, Rex Taylor, Bob Rhoades and Roland Harper, and I believe all were pilots. Scale documentation wasn't required. These things were judged: fidelity to scale, workmanship and features, and finish and realism. The two judges on each team agreed on a score between 0 and 10. ARFs were allowed.

The flight-performance judging procedure was also very simple. Again, each team of judges agreed what the score was. Judged were taxi and takeoff; flight maneuvers and pilot skill; scale flight style and speeds; and landing to stop or turn off. The Cub had to fly like a Cub, and the P-51 had to fly like a P-51. No special maneuvers were required. All the pilot had to do was to demonstrate typical maneuvers that the full-scale aircraft did.

There were nine awards (see winners' chart). The overall winner of the competition was Forrest Edwards, with his magnificent, 9.5-foot-span Russian Polikarpov biplane. Forrest earned

craft. A Piper Cub with an O.S. 1.20 or 1.60 twin with long pipes and being flown at a patient light throttle setting may sound more like a real Cub than an exotic Saito 5 cylinder sounds like a Pratt&Whitney R-2800. Close your eyes briefly and listen to the sound to compare the model to the full-scale aircraft it represents."



This 5-cylinder, supercharged radial engine was scratch-built by Forrest Edwards to power his Polikarpov PO-2 biplane. It ran beautifully.

Co-judge (Rex Taylor) and I had trouble with the sound judging. I felt the problem was directly related to propeller sound. The technical definition of what is desirable in scale sound is difficult because of our own preconceived opinions of what it should be. The main difference between model and full-scale aircraft-engine sound is the propeller sound. The propellers on a full-scale aircraft with a radial engine turn under 3,000rpm. A scale model radial engine turns a prop at 6,000 to 7,000rpm or higher. Full-scale propellers make a tremendous amount of noise, and that noise doesn't scale downwards to our models. The scale-sound concept is a good one, but we must define what is possible in this area. From this meet, it wasn't clear what the limitations are. This was the first time that the issue had been addressed in a competitive setting. My conclusion was that more research should be done to determine how one engine/propeller combination can be judged as superior to another. However, we were able to arrive at a sound score that probably was fair to the contestants. The main thing we looked for was flying at scale throttle setting, especially for low-performance aircraft.

awards for Pilots' choice, Most Realistic Flight, Best Mechanical, Best Military and Best Single-Engine Sound. The model and engine performed flawlessly. Bud Davis's scratch-built Piper L-4 Grasshopper was flown by Rick Maida, who nailed down very high flight scores with a totally convincing performance. Earl Thompson (7th place '91 Scale Masters) flew his Gloster Gladiator, but was put out of the running when his big bipe flipped over on takeoff and sustained minor damage to the top of the rudder. Overall, it was very hard to tell the models from the real thing.

The real winners of the competition were those who flew in a scale meet for the first time. They all had a ball. All kinds of scale ships were entered: not-so-scale-looking ARFs, sport-scale kits like Goldberg Chipmunks, and aircraft that had been entered previously in Scale Masters competitions.

In talking with the modelers who came to observe, many said they would enter next year. That ultimately sums up the success of this type of low-key competition put together by Evan Wolf and his coworkers.

Special thanks go to all the sponsors who contributed to the success of the event. *These include: Airtronics Inc., Balsa USA, Bob Holman Plans, C.H. Electronics, Du-Bro Products, Futaba Corp. of America, Landing Strip Hobbies, Proctor Enterprises, Propwash Videos, RAm, Royal Products Corp., Sig Mfg., Scale R/C Modeler, Sullivan Products.* ■

ENGINE REVIEW

Real Performance Measurement

by DAVID GIERKE

Featuring In-Flight Testing

NELSON 40Q QUICKIE 500

BACK IN APRIL, the phone rang while I was up on a ladder painting a wall in our loft. My wife, Carolyn, told me it was Tom Atwood, editor of *Model Airplane News*. He wanted to talk to me about testing some engines. My first thought was "Nobody wants to read about this stuff; testing is complicated and boring."

After talking to Tom for a while, I changed my mind. Maybe there *is* a way to write about a very technical subject without putting readers to sleep! It's now the end of July, and over the past three months, a lot has happened! My old engine-testing machine has been dusted off, updated (thanks to Bill Hauth!), tested, debugged and proclaimed ready for work. My Condor Hobbies* telemetering device—purchased two years ago and never used—has been tested, with exciting, positive results. Engine-test log books have been dusted off and procedures reviewed. The cobwebs of more than a decade of inactivity in the small-engine-performance-testing domain have been swept away by running a couple of engines on the new/old dynamometer. Many telephone calls and a few letters to Tom at the *Model Airplane News* editorial offices have finally resulted in this first installment of RPM; as the title says, Real Performance Measurement is our goal.

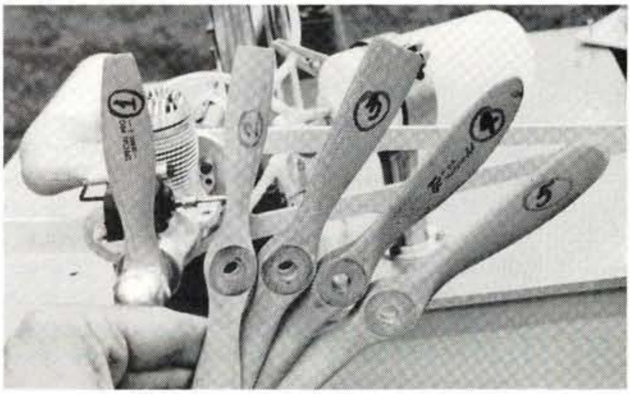
"Real Performance Measurement" goes much further than any other engine review series has attempted to go. We think enthusiasts want to know:

- what to look for before running an engine;
- whether it needs breaking-in or can be flown right away;
- what fuel to use;
- how to adjust the needle valve and the throttle;
- which propellers should be used for a particular engine/airplane combination;
- how to get the most out of a particular engine/prop/airplane combination in a variety of weather conditions and flying locations.

Finally, I will comment about what I like and don't like about the engine—hits and misses.

I won't usually give detailed explanations of an engine's construction, metallurgy and design. No, I will not measure induction or cylinder timing, cylinder-head volumes, bore and stroke, etc. I will not calculate cylinder displacements, crankcase volumes or compression ratios! It has been my experience that most modelers are more interested in performance factors and figures (let me know if you disagree).

As Tom likes to say, "Readers should finish an article feeling that they have learned something or gained some additional perspective." We feel that this is possible only if modelers/sport fliers actually read the material without drifting off. I will work to keep the technology to an understandable level, knowing that people from diverse backgrounds will be reading this column (not just engineers!).



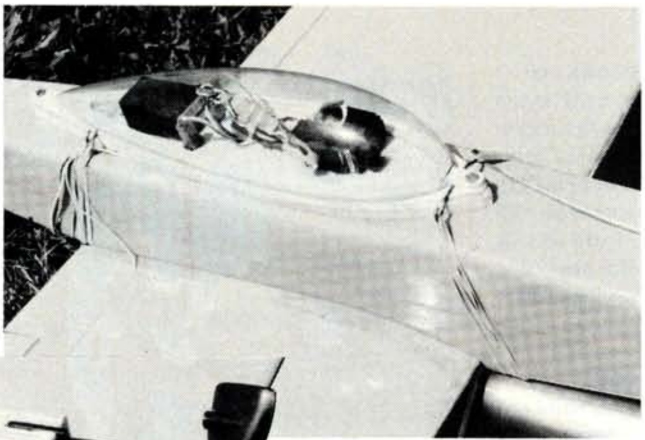
The load props used for dyno-testing the Nelson 40Q.

This doesn't mean that an in-depth discussion can't or won't occur as the need arises.

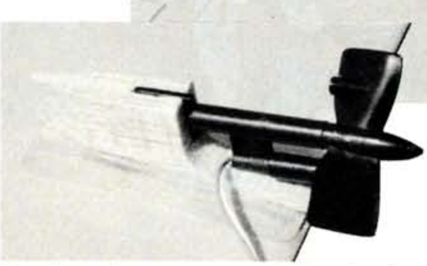
Expert modelers of the competition variety can also benefit from our dyno-testing and in-flight work. They will generally have to interpret what the data provides. If the readers of this column (and I hope there will be many!) want to know about dynamometers, the effect of atmospheric changes, or want information on any other engine-related technology as it applies to model airplanes, Tom assures me that space will be provided!

So what about this Real Performance Measurement (RPM) business? The process consists of static-testing an engine on a dynamometer and collecting data that allow me to calculate the engine's horsepower through its practical operating speed range. This, in itself, is hardly new; several reporters on engine performance have done this. Peter Chinn and Mike Billinton come to mind.

What makes my technique different is that I also flight-test typical model engines and record in-flight engine speed (revolutions per minute) and air speed information.



Rubber-band-held canopy contains telemetering equipment. Model: Neil Watson Quickie 500.



The air-speed sensor tape mounted on the wing.

The in-flight data is telemetered to the ground where it is manually recorded. I try several props, until I'm satisfied that the usable performance range has been covered. I'll also give the test pilots' opinions about which propeller/engine/airplane combination they liked best, i.e., which combination pulled best through turns and climbs, etc.

As well as engine speed and air speed, I also collect information about the atmosphere, since its condition will directly affect engine horsepower. Barometric pressure, temperature and humidity are noted. I record the engine's ground (static) rpm, and I measure and record its sound level 9 feet away from it. I make a few calculations, e.g., of air density (RAD); they allow me to determine how well an engine could perform during an actual flight. All this helps me to determine which propellers should be used on a particular model and what air speed should be expected on a given day.

I have to admit, this process has been difficult to get rolling! As with any technology, problems occur, equipment breaks down, it rains, glitches occasionally crop up, and the data obtained is only as good as the person interpreting it! Sometimes, the calculations don't make sense, and the test has to be run again—not my favorite thing! From all of this, I hope that you are getting the impression that RPM is a labor of love; it really is!

DATA POINTS FOR THE 3 STATIC ENGINE TESTS:

1. Nelson 40Q—Quickie carb. (.345 bore)

RPM	x I	= BHP	x CORR. FACTOR	= CORR. BHP
18,200	132	2.38	1.06	2.53
18,500	139	2.55	1.06	2.70
19,700	130	2.54	1.06	2.69
20,100	126	2.51	1.06	2.66
22,500	112	2.50	1.06	2.65

2. Nelson 40Q—Perry carb. (.375 bore)

RPM	x I	= BHP	x CORR. FACTOR	= CORR. BHP
18,000	117	2.09	1.05	2.19
18,400	120	2.19	1.05	2.30
19,,200	116	2.21	1.05	2.32
20,000	109	2.16	1.05	2.27
22,600	96	2.15	1.05	2.26

3. Nelson 40Q—Open exhaust (Quickie carb.)

RPM	x I	= BHP	x CORR. FACTOR	= CORR. BHP
17,500	122	2.12	1.04	2.20
19,100	121	2.29	1.04	2.38
19,900	120	2.37	1.04	2.46
21,000	116	2.42	1.04	2.52
22,300	100	2.21	1.04	2.30

Fuel—15% nitro, 20% oil (10% castor, 10% klotz)
Fuel consumption—1.8 fl. oz./min. at 19,000 rpm w/Quickie carb
Glow plug—Nelson
Idle rpm—Perry Carb—3,500

NELSON 40Q TEST

Let's get on with it! This month's subject is the highly acclaimed Nelson* 40Q (Quickie 500).

The Nelson 40Q arrived with a Perry carburetor attached and a muffler that looked similar to many other engines of this displacement. The fact that the unit's exit-hole diameter measures only 1/4 inch raised an eyebrow. Might this "muffler" really be a tuned pipe? We would find out for sure later, after some tests.

The engine also came with the black plastic Quickie 500 carb, which was also tested. The Perry has the ability, by virtue of its design, to be throttled, although not too successfully on this engine, as we will see. The pleasant surprise for me was that Henry Nelson used all Allen-head machine screws, SAE variety, in the assembly. The glow-plug size isn't standard; it was manufactured by Nelson for this engine. Six extra plugs were included for my tests, and I needed all but one. Dyno-testing is sometimes hard on glow plugs!

The needle-valve assembly for the Quickie carb incorporates a nice racing-type needle with locking collet similar to those used on Super Tigre or K&B units. Quickie 500 pylon-racing rules state that the carburetor barrel must rotate and be able to shut off the engine. This unit does just that; it rotates! There's no intention of throttling—strictly full throttle or "off"! No spray bar protrudes into the venturi. The fuel travels from the spray bar through a small hole and directly into the venturi.

The engine comes equipped with a handy radial mount that is an integral part of the backplate assembly. Most racers opt for this quick, light method of mounting their engines.

The other noteworthy item was the diameter of the crankshaft: a healthy 5/16 inch—the size you find in most .60s. Usually, I remove the cylinder head and backplate on any new engine to inspect for metal chips left over after machining. But I spoke to Henry

Nelson at this year's AMA Nationals, and he assured me that the engine was ready to run and required no break-in. Since the piston and cylinder is of the ABC variety (aluminum piston with brass chromed cylinder), I took his advice and simply proceeded with the testing. (In future columns, I will discuss the pros and cons of using careful inspection and break-in procedures for ABC and other piston-cylinder types.)

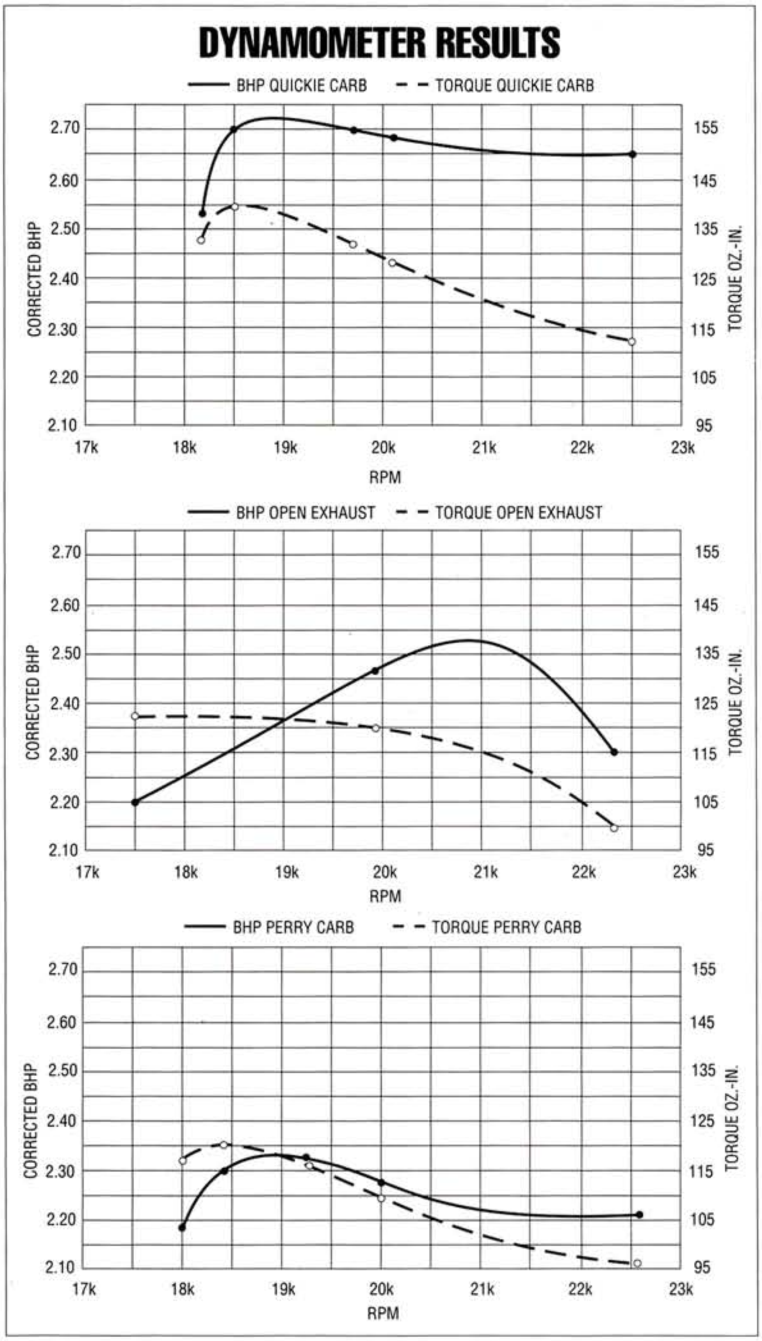
DYNAMOMETER TEST

My dyno is homemade. You could build one if you were really into engine work. It's a great little instrument for engine modifiers who need to measure the results of their work! The unit I built is crude compared with the sophisticated units that are used in the automotive industry. Their dynos are tied into computers that not only control, but also retrieve thousands of bits of information per second. My unit follows the same basic principles, and I've found that careful measurement and quite a lot more time makes up for a lack of sophisticated machinery.

Long-time engine-review columnist Peter Chinn is reputed to have an electric dynamometer. With this unit, he can change the load (amount of work) an engine is subjected to simply by turning a knob that changes the resistance of an electric generator circuit.

My dyno requires that a group of *load propellers* be individually operated on the test engine. That means the engine must be started, adjusted and shut off at least six times for a complete test. The six propellers aren't necessarily flight props; they merely represent sizes that will force the engine to operate at different rpm, e.g., a 9x6 1/2 Rev-Up* series 400 C cut down to a 7 3/4-inch diameter will let the Nelson turn 22,500rpm. This is a low-load prop. On the other end of the series is a high-load prop, such as an 11x6, which will force the engine to work hard and run much more slowly—about 17,000rpm.

During an open-exhaust test, author adjusts the needle valve while taking RPM readings using a Royal Pro Tach tachometer. (Note the eye and ear protection.)



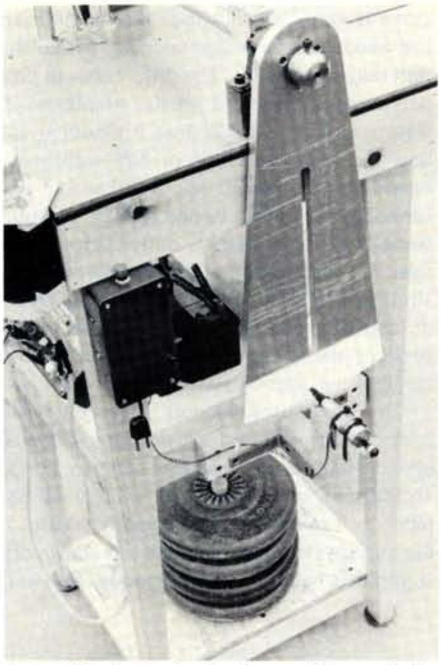
The idea here is to fashion six props that will make the engine operate at about 1,000rpm intervals. By measuring the torque at these intervals, along with the shaft speed (rpm), the brake horsepower (b.hp) can be calculated. (I'll get into the specifics of how the torque measurements are obtained when I have the space.) The graphs show the results of three dyno tests in which b.hp has been calculated. These are for the Perry carburetor, the Quickie carb and an "open" exhaust test. All these tests were done using 15-percent-nitro fuel, which is specified for Quickie 500 racing, and 20 percent oil (10 percent castor; 10 percent Klotz).

Notice that each graph shows a horsepower curve and a torque curve. The thing to look for on these graphs is the peak, or maximum output obtained.

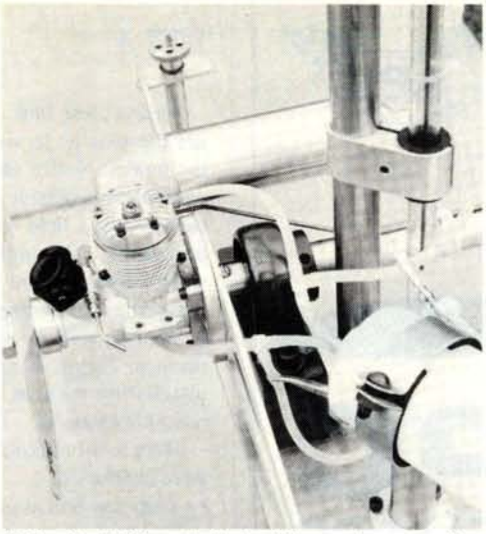
I first tested the Perry carb at wide-open throttle and was surprised by the results. I wasn't surprised that it produced 2.33b.hp at 19,000rpm as much as I was that the horsepower didn't fall off much at the higher rpm. It was still producing over 2.10b.hp at 22,500rpm—my lightest load point. Torque also held up, exhibiting a very flat curve throughout the rpm range.

Another thing to look for is how close the b.hp and torque peaks are on the rpm scale. Let me just say that the 500rpm separation is very unusual!

Finally, racing engines of this class usually exhibit peak horsepower much higher on the rpm scale. What was going on here? Did I make an error on the test? Just in case, I ran the entire series again—same results! Oh, by the way, the Perry idled down to a not-so-slow 3,500rpm. Again, not surprising!



Rear of the dyno, showing the pendulum weight. Note the solenoid-actuated recording pen.



Notice the T-fittings in the fuel line and pressure line. These allow switching to a long, graduated, glass tube (buret) to make fuel-consuption measurements.

COMPARISONS OF STATIC AND AIRBORNE DATA

Prop Mfg. & size	Ground rpm	Air rpm		True Air speed mph		dB at 9 feet	Relative Air Density (%)
		TURN	STRAIGHT	TURN	STRAIGHT		
REV-UP #400c $8^{3}/_{4}$-$6^{1}/_{2}$	19,000	20,500	22,000	130	155	–	93.8
REV-UP #400c 9-7	18,700	19,500	20,500	118	161	112	93.8
REV-UP #400c $8^{3}/_{4}$-$7^{3}/_{4}$	17,500	18,500	19,000	130	155	–	93.8
Master Airscrew 9-8	16,000	18,000	19,000	130	155	–	93.8

With many un-answered questions, I decided to run the Quickie carburetor for a full test. Notice the results here. The most b.hp I've ever seen for a sport .40 engine: 2.72b.hp at about 19,000rpm, and still producing 2.65b.hp at 22,500rpm! This engine just didn't act like any "normal" 2-stroke I've ever tested. That tiny exhaust hole in the muffler convinced me that I needed to run yet another test—a so-called "open-exhaust" test. So, off came the muffler, but how would I pressurize the fuel system?; the pressure fitting was on the muffler.

I decided to drill through a backplate screw hole into the crankcase, use a pressure fitting with the correct thread and go from there with un-timed crankcase pressure. This worked well. Notice the graph for open exhaust. This is what I'm used to seeing: a more peaky horsepower curve, still impressive at 2.52, but occurring at higher rpm (20,800). The torque curve was still very flat until the highest rpm, where it finally fell rapidly. It peaked at 18,500rpm—2,300rpm separation with peak b.hp.

At this point, I knew the muffler played a huge part in the performance of this engine. I would have liked to disassemble the unit to see how it was constructed, but I couldn't unscrew the aft aluminum "can" with a moderate twist, and I didn't want to risk damaging the unit. I guess that it's probably of the "magic muffler" design, which was successfully developed in Australia more than a decade ago. Whatever its design, its tuning effect sure works!

Before we go on to the flight tests, I'll make a few general statements about interpreting these output curves:

- The highest torque allows the engine to accelerate at its greatest rate, up the rpm scale.
- The highest b.hp point is where the model will attain its greatest velocity.
- When the torque peak is closest to the b.hp peak, the engine will move from a loaded-down condition most quickly, i.e., it should accelerate out of a turn very quickly.
- Flat horsepower curves mean that a great variety of propellers will probably work well.
- Max hp occurring at such a relatively low rpm means that a greater variety of propellers can be used (pitch and diameter).

FLIGHT TEST

Henry Nelson suggested that I use an extremely well-built Quickie racer for these flight tests. Many traditionally constructed models folded their wings in early flight testing. Reputations have a way of getting around; I heard this rumor months ago!

The real meat of our engine-testing procedure is flight. My Condor telemetering system allowed me to measure air speed and engine rpm throughout the flight envelope. The system consists of an airborne transmitter, an air-speed sensor and rpm sensor, a servo-actuated switch for changing from one sensor to the other, and a ground-based receiver/monitor. A retract channel and an airborne battery pack completed the package.

Condor states the principle of operation as: "cadmium disulphide optical sensors (photovoltaic cells) react chemically to subtle and rapid changes between light and dark to modify an electric pulse. The modified pulse is fed into the airborne transmitter and is relayed to the ground-based receiver/monitor, which then decodes the signal and displays it in usable form on the monitor."

RPM

Take a close look at the photos, and you'll get the idea as to where the sensors are on the model. Notice also that the telemetering equipment is outside the model in a modified canopy that's held on the fuselage with rubber bands. Although it's small, there just wasn't enough room inside the model for the metering equipment. Since this method worked so well for the initial tests, I'll continue to use it. It allows rapid equipment installation without disrupting the model's other components.

Here's a breakdown of how these tests were conducted:

- a prop was bolted onto the engine;
- ground rpm were recorded;
- airplane was flown around a simulated pylon-racing course;
- engine rpm were recorded at two points: in a tight scatter-pylon turn and at the end of a straight flight path;
- airplane's true air speed was recorded at the same two points;
- atmospheric conditions were recorded as in the previous dyno tests.

The tests went off without a hitch. The engine/airplane combination worked well and needed only moderate trim adjustments. (The Nelson weighs less than the model's original Rossi.) The telemetering worked flawlessly.

Look at the chart. The results speak for themselves. Of the four props tested, the Rev-Up 9x7 gave the highest end-of-the-straight speed of 161mph! Notice that it slowed to "only" 118mph in the turn. Ground rpm was 18,700, and in-flight rpm was 19,500 in a turn and 20,500 in the straight.

The other three props, although quite different in dimensions, gave impressive air speeds. Notice how they performed better in the turns, but not as well in straightaways. One problem with propellers: what's written on the blade by the manufacturer isn't necessarily what you get; identically marked props might not be identical! The performances of these—mostly wooden—blades vary widely. I suggest that you try to match the prop size with the *ground rpm* from the chart. In this way, you'll come close to duplicating my test results. Competition racers sometimes check *dozens* of props with a pitch gauge to find the one they know will give maximum performance!

CONCLUSIONS

So, you ask, what does all this mean? How do all these tests show me something I need to know about how to use the Nelson engine?

First, the test model was heavy (more than 4 pounds), and it had higher than usual drag because the telemetering equipment was hanging out in the slipstream. Since the b.hp curve is very flat from 18,500 to 22,500rpm, just about any prop that operates within this rpm range will work. The differences in prop performance depend on the airplane: its weight and how much drag it exhibits, and how it's flown in terms of how tightly it's turned about a pylon. The Rev-Up 9x7 performed poorly when turned tightly, probably because of the airplane's deficiencies. If the turn was opened up slightly, however, the slowing would be reduced. The combination of large diameter and a heavy airplane didn't produce the desired effect/performance as, lap after lap, speed measurements confirmed.

The high-pitch Master Airscrew* 9x8 prop was too much load on the ground. It only allowed the engine to turn about 16,000rpm, at which point it "fell off the pipe" as it overheated and became erratic. In the air however, it cooled and ran admirably. It showed decent turning speeds, although straightaway speeds suffered somewhat as it labored to reach peak hp.

This engine just didn't act like any "normal" 2-stroke I've ever tested.

Test pilot Neil Watson liked the Rev-Up $8^{3}/_{4}$x$7^{3}/_{4}$ prop best. He thought it pulled well through the simulated pylon turns and showed excellent speeds on the straights.

No matter which propeller we use, it will have fixed pitch and diameter. Each represents a compromise, at best. Some props work better under high loads, e.g., when a model makes a tight turn, and others work more efficiently in a relatively low-drag situation, e.g., when a model is flying straight and level. No one propeller will work best in all conditions, including takeoffs, where high pitch means slow acceleration—right, pattern fliers?

The "constant-speed" propeller seems to be the ideal solution to the compromise problem. Operate the prop at a given rpm (like at the peak b.hp rpm), and when the load changes, the prop's pitch will automatically change and keep the engine running at the same speed. Pattern fliers had such an animal (manually adjusted?), but does anyone use one today? If not, why not? Maybe someone who has had experience with one of these units will write to me about it.

Sound-level measurements indicated a not-so-quiet 112dB at 9 feet. Fuel consump-

(Continued on page 106)

SMALL STEPS

RANDY RANDOLPH

BARGAIN-BASEMENT ELECTRICS AND OLD PROPS

Emmett Fry and his latest Stosser.

AS WE'VE SAID before, modelers who fly small airplanes are often the hobby's most creative and ingenious. The following letter from William Whitten of Birmingham, AL, proves this point.

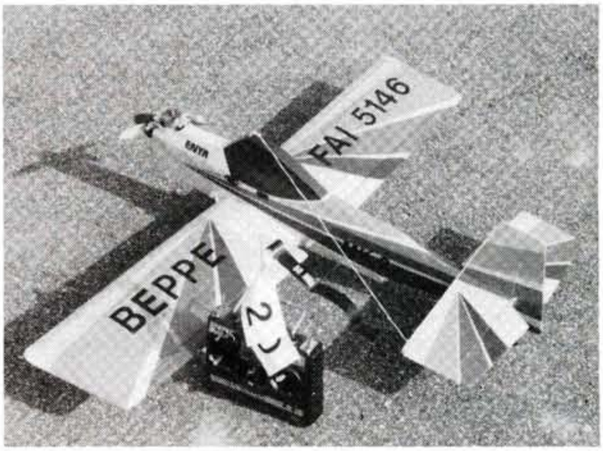
"...I've flown several electrics, including the Electrostreak, a Goldberg Electra (modified with a landing gear and a hotter-geared, 05 motor), a friend's Etude and a small plane of my own design. The last flies very well on an 035 ferrite motor from an electric screwdriver using four, 700mAh, Sanyo* AA Ni-Cds. It's a tad heavy at 19 ounces, but loops, rolls, etc., are no big strain. It has 185 square inches of wing area with the same airfoil as the Ace* foam wings. The wingspan is 33 inches. Controls are rudder, elevator and motor. The homebrew resistor-type speed controller is crude, but lightweight and cheap, and it works well enough to land the plane...

"The motor used in this home-built plane is a real bargain. It's from a Black & Decker* cordless screwdriver. You can get the whole thing, including charger and a pair of sub-C Ni-Cds, for $15 to $20. The motor alone is available for about $6 if you prefer. It's a Johnson 3209—the Black & Decker part number is BD143157-02. On four cells, it will turn a Cox* 6x3 prop at 11,500rpm at 12 to 13 amps, about the same as the Elf-50 from Hi-Line*, though it isn't the same motor. (A Skil cordless screwdriver has what seems to be the same motor as the Black & Decker, but it costs only $4—part no: 1-347928; item no: 90347928.) A Du-Bro* waterproof pushrod guide serves admirably as a prop adapter.

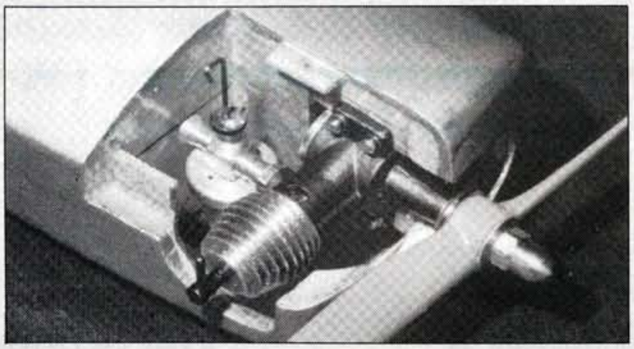
"I mentioned using Sanyo, 700mAh, AA cells; nobody else seems to have tried them. They're the same size as normal 550mAh to 600mAh Sanyos and have almost as much capacity as 800mAh cells. With considerably less weight, they give a nice steady run at 12 to 13 amps. My own home-built plane doesn't fly nearly as well with four, 800mAh cells as with the 700mAh cells; the $1^1/_2$ ounces make a difference. I get them at the hobby shop...

"Most of the microservos and receivers cost a bundle these days, but I've found a couple of bargains useful for small planes. Tower* offers a Kyosho* KS-31 miniservo for $20. It weighs .2 ounce more than a Futaba* S-33, but that isn't a bad tradeoff for a third less money.

"As for receivers, I've gotten two different Aristo-Crafts*—the HP-4RN72D and the narrow-band HY-5RN—at local hobby shops for $18 and $22, respectively (without crystals). Both weigh an ounce as is, but if you remove their cases and wrap their PC boards in shrink-wrap, you can get them



This Enya CX .11-powered Chips (Model Airplane News, March '90)—renamed Beppe Mk II—was built by Giuseppe Fascione of Rome, Italy, who's a prolific builder and long-time "Small Steps" correspondent.



A DIESEL REBORN

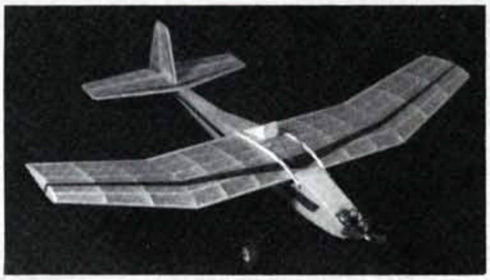
The British Mills 75cc (.045ci) diesel is displayed here in all its glory. Dereck Woodward reports that in 1960, its sales were slow, but now, Irvine can scarcely keep up with demand. Currently, Mills engines are produced in India from the original dies. Their 1.3cc (.080ci) engine is popular for the new A-Texaco competition.

The Mills diesels, as well as most other diesels and many glow imports, are available from Carson Engine Imports, 814 East Marconi Ave., Phoenix, AZ 85022.

SKOOTS STANDS ALONE

Few kits are designed especially for the Cox .010 engine. The "Skoots"—a high-performance, 2-channel airplane that made its debut at the Little Rock Small Steps II Fly-In last summer—is almost alone in that field. Immediately, there was a line of people waiting for turns at the stick.

Its unique, light, strong design by Jesse Shepherd—a long-time indoor flier—weighs less than 6 ounces, including engine, radio and two miniservos! The windshield and cockpit ("pilot kit" included) are easily and quickly removed for flight. The deluxe Skoots kit includes all hardware, cut parts, bent wire, large rolled plans, instruction manual, Japanese tissue for covering and light wheels.



It's available at hobby shops and from Aero-Craft Models, 2713 Summit View, Bedford, TX 76021, for $39.95 (postage paid).

down to half of that. The HP-4RN72D is a mini and the HY-5RN is even more compact. I don't know if it's a true narrow band, but that's what its label says, and the Futaba J connectors fit well. With a 50mAh receiver battery, three servos and receiver cost under $100 and weigh 4 ounces. I don't think that's bad at all! (I should mention that these receivers are probably not current models and may no longer be in production. At these prices, it would be worth checking around for them though.)

"If I might suggest a couple of ideas for future columns, perhaps you could survey the current smallest/lightest radios available, especially those with servos. A comparison of their sizes, weights, prices and current drains would be very valuable. Current drain can be a real concern if you use tiny receiver batteries. The servos I've checked vary widely. They seem roughly equal at rest, but with a gear removed so the motor can run freely, they vary widely."

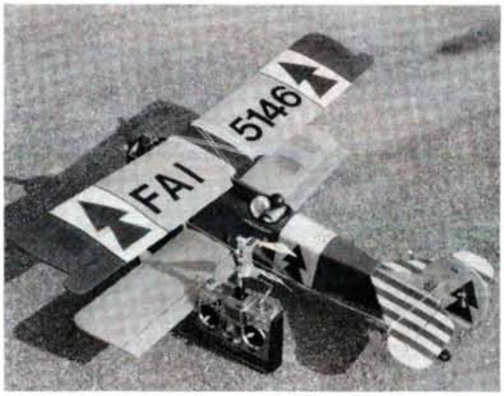
Quite a letter William; thank you! Some time ago, I wrote to all of the major radio-system manufacturers asking for information on the weight and current drain of their mini systems; only Futaba responded! That made it difficult to present any kind of article.

The speed controller for William's electric consists of a coil of bare wire, wound around a $^3/_8$x$1^1/_2$-inch dowel. The wiper is mounted as an extension of a servo arm and connected in series with the motor/battery circuit.

"THIMBLE DROME" PROPS

William also passes along the following: "...I did run across an item you may find interesting for small planes. I tried several props on my electric GLH: the Cox nylon 6x3, the gray 6x4 and 5.5x6, a folder 6x4 and a couple of others. The Cox grays flew OK, but broke on almost every other landing, and the folder was a dog. I poked around the 'old prop bin' at a long-time hobby shop and rooted out some ancient Cox, white nylon 6x4s, which worked just great. They're so old that they have "Thimble Drome" on them instead of "Cox." The blades are narrow with rounded tips, similar to the old nylons from Top Flite. They seem to turn better than the Cox gray 6x4s, and they don't break on landing..."

These props haven't been made in years, but there still may be some around. They might be worth looking for if you fly small electrics.



Flight performance with another of Giuseppe's creations—an O.S. .26 Surpass-powered Fokker D-VII from a Marks Models kit—is very realistic.

MAILBAG

Our friend Gene Haynes of Lopez, WA, writes that the 4.8V, 250mAh cellular-phone batteries stocked by Radio Shack weigh about $1^3/_4$ ounces and work very well in small, 2-channel systems.

A while back, I wondered why the small, schoolyard-scale Boeing L-15 had been neglected. Letters from the faithful prove that it has only been neglected recently.

In 1947, the venerated, *Air Trails* magazine printed full-size plans for a U-control version. In 1948, *Flying Models* magazine published plans for a 30-inch, rubber-powered version. "Small Steps'" British connection, Dereck Woodward, informs me that a 50-inch, gas-powered, free-flight version appeared in *Aeromodeler* magazine in about that same era. Now, those who are interested at least know where to start looking!

STUCK ON STOSSERS

Emmett Fry of Little Rock, AR, is one of the guiding lights behind the Small Steps II Fly-In which is held each summer in Little Rock. To say that he's smitten by the Focke Wulf Stosser is an understatement; the Enya* .15-powered, 3-channel beauty is his third. With a 21-ounce-per-square-foot wing loading, it's a brisk flying machine.

**Here are the addresses of the companies mentioned in this article:*
Sanyo Electric/Battery Division, *200 Riser Rd., Little Ferry, NJ 07643.*
Ace R/C Inc., *116 W. 19th St., Box 511C, Higginsville, MD 64037.*
Black & Decker, *P.O. Box 40903, Raleigh, NC 27629.*
Cox Hobbies, *350 W. Rincon St., Corona, CA 91720.*
Hi-Line; *distributed by Charlie's R/C, 2828 Cochran St., Simi Valley, CA 93065.*
Du-Bro Products, *480 Bonner Rd., Wauconda, IL 60084.*
Tower Hobbies, *P.O. Box 9078, Champaign, IL 61826.*
Kyosho/Great Planes Model Distributors, *P.O. Box 4021, Champaign, IL 61824; (217) 398-3630.*
Futaba Corp. of America, *4 Studebaker, Irvine, CA 92718.*
Aristo-Craft/Polk's Model Craft Hobbies, *346 Bergen Ave., Jersey City, NJ 07304.*
Enya Model Engines/Altech, *P.O. Box 286, Fords, NJ 08863.* ■

GREAT PLANES

Spirit 100

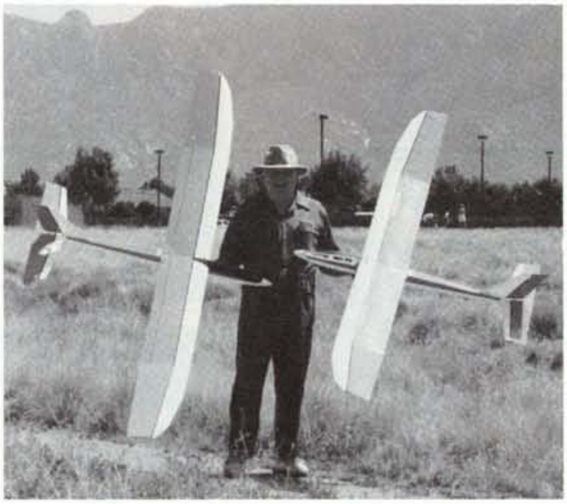
by JIM SIMPSON

THIS UNIQUE KIT contains the parts to build a glider with either a sport wing (with no ailerons or flaps, and optional spoilers) or an advanced wing that includes both ailerons and flaps.

Building the advanced-wing version is very simple because the ailerons and flaps create the wing's undercamber, so the main wing structure can be built flat on the work surface. The high degree of prefabrication—shaped leading and trailing edges, ailerons, flaps, elevator, nose block, etc.—considerably reduces building time. The high-quality wood appears to have been graded properly. For instance, the straight fuselage sides and doublers are as tough as nails, and the straight-grained wing planking is easy to bend toward the airfoil contour.

PLANS AND INSTRUCTIONS

The Great Planes* Spirit 100's clear, logical plans could be framed and hung as art. They're very easy to read, because they're printed with black ink, not with "magically disappearing" blue lines. Best of all, one side of the plan shows the sport-wing version and the other shows the advanced-wing version, so there's no guessing about what goes where.



PHOTOS BY TAYLOR COLLINS & JIM SIMPSON

FLIGHT PERFORMANCE

• **Takeoff and landing**

Sport version: I balanced the plane with the tow-hook in the second hole back. Then, I suspended the plane upside-down by the tow-hook. The tail hung slightly lower than the nose (about 2 to 3 inches). Thus trimmed, the launch was a thing of beauty. High. Straight. True.

When I first flew the sport version, the spoiler cord I used stretched a little, and the servo wasn't strong enough to overcome the return springs (small rubber bands), so the landings were smooth and graceful, but the plane skidded a long way. About a week later, I changed the cord and servo so that the spoilers would stand up about 60 to 70 degrees from the closed position. This slowed the landing approach to a walk. Holding a little up-elevator makes it even better! In all cases, the plane stays right on heading after touchdown, all the way to a complete stop.

Advanced version: I was so anxious to try this setup that I failed to program in a coupled aileron-rudder mode. I rationalized that, since I use lots of rudder when flying power planes, it would be simple to just go ahead and fly them uncoupled. Wrong!

I didn't crash; I just couldn't fly it as well as I could after I reprogrammed the radio. Then, the launches were much smoother and higher without any heading deviation.

By the way, the advanced version balances with the tow-hook in the third hole back when it's suspended upside-down by the tow-hook. Launches are straight and true with no flap deflection, and even better with about 15 degrees of deflection. It isn't any better when flap deflection is more than this.

The first landing I made while using the crow mode was such a thrill that I had to shout about it. The only thing I can relate the crow mode to is the drag chute on a B-52. Boy, does it slow the plane and make the landing a piece of cake! With the flaps at 80 degrees and the ailerons at 40 degrees, I still had solid heading control, and the slide after touchdown was less than with the sport version with 60 degrees of up spoiler. Fantastic!

• **High-speed performance**

My first test was to put the plane in a shallow dive until the speed stabilized to see if it would hold the dive, zoom-out, or tuck-under. I anticipated flutter while waiting for the speed to build, so I planned to pull up, pop the speed-boards (spoilers) or use crow. As it happened, neither the sport nor the advanced version fluttered, but both gently zoomed, meaning that more trim and a change of CG are required. These adjustments will take months of trial and error, but they will be worth the effort.

The second test was a short, vertical dive. Again, no flutter. (Both models are covered with MonoKote and use MonoKote hinges.) Both made several consecutive loops after the speed-building dive without losing heading. Again, impressive flight performance.

The third test was a long, vertical dive, but I was hoping that someone else would do it because I liked both airplanes too much to risk it! No such luck, but I did the test and they survived. On the sport version, I put the spoilers all the way up before nosing-over, and I left them up until I looped off the excess air speed at the dive's end. On the advanced version, I used the crow mode to maximum in level flight before the nose-over and again left them that way until I finished looping the plane at the dive's bottom. Am I pleased with these planes? You bet I am!

• **Low-speed performance**

The sport version's thicker airfoil and greater dihedral make it very stable in flight. When making the transition to slow flight from cruise speed, it's possible to stall by using too much up-elevator. When the sport version stalls at higher speeds, it quickly drops a wing (left or right) but also recovers quickly with down-elevator and opposite rudder. When stalled from slow flight, the plane simply mushes straight forward and recovers immediately with a touch of down-elevator.

The advanced wing allows even slower flight. The flaps can be dropped about 15 degrees and, if camber-changing is used, even the ailerons can be dropped by about the same amount to allow the plane to loiter. Thermal searching, however, is more fun in cruise-speed ranges.

• **Aerobatics**

This is one of my favorite things, though I don't know why, since aerobatics never add to my points in a sailplane event. Maybe it's just the old pattern pilot coming out. At any rate, I'm pleased to report that both versions of the Spirit are very aerobatic. Both loop very well, but you can really tighten them up on the advanced version by using as much as 40 to 50 degrees of flap.

The sport version will roll from high-speed, level flight, but you must use maximum rudder throw. Be patient, and time down-elevator perfectly when inverted to avoid slowing the plane too much. The advanced version rolls quickly and cleanly from normal cruise speeds.

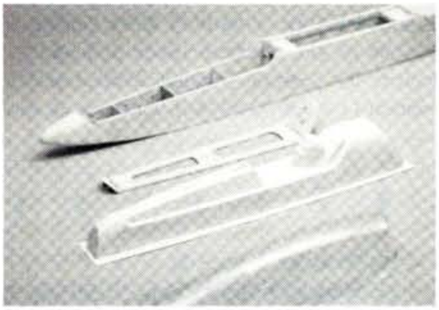
The advanced-wing version does the fancy maneuvers (combinations of loops and rolls) such as Cuban-8s, very nicely. The sport version requires more air speed and greater finesse owing to the absence of ailerons.

Both versions will fly inverted, but they require lots of down-elevator and mid to high speed ranges.

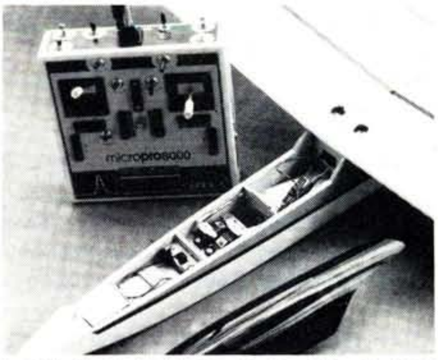
The 55-page instruction manual incorporates the best of all worlds. Numerous drawings and photos supplement the checklist-style text, which also contains many fine tips. The last eight pages are devoted to pointers on balancing, trimming and flying. There are even sections about thermal, slope and contest flying. The back cover contains a 2-view line drawing of a plane. You can use this picture to design your color scheme. How could it be any better?

CONSTRUCTION

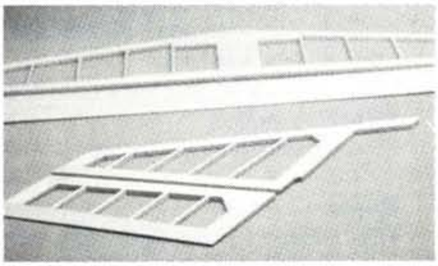
After the sides have been put together, assemble the traditional box-construction fuselage over the plan's top view. Made of a lightweight plywood (not lite-ply), the bulkhead, employ a tab-lock construction system that makes fuselage construction easy. Balsa



The balsa-and-plywood Spirit fuselage is built upright over the plan top view. The canopy includes a balsa-and-plywood frame, a lightweight plastic inset and a clear plastic bubble. I left out the plastic insert in my models to simplify the setup.



Installed in the Spirit 100, the Ace MicroPro 8000 provides great control. From left to right: radio compartment—ballast, battery and switch, rudder and elevator servos and receiver. In the advanced version, there are three more servos in the wing.



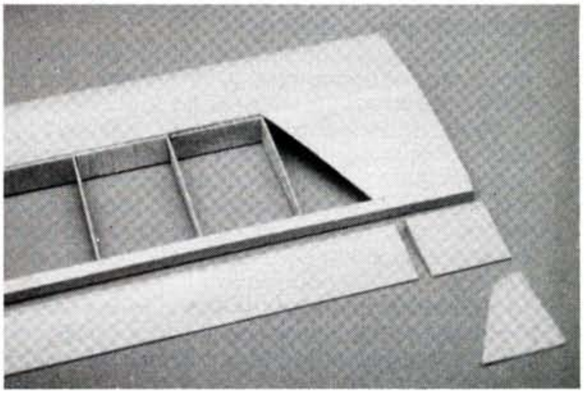
The Spirit 100 all-balsa tail group is easy to build and features a solid, pre-shaped elevator.

doublers at the wing-saddle area run to about $3\frac{1}{2}$ inches aft of the saddle's trailing edge. Doublers are also used at the horizontal stab-attachment location for added strength.

Electronics are placed below the canopy so that the area under the wing is available to hold additional ballast. (A box just above the tow-hook can accommodate up to $2\frac{1}{2}$ pounds of ballast.) With the radio under the canopy, you don't have to remove the wing to access the electronics. Finally, the fuselage bottom is sheeted with $\frac{3}{32}$-inch plywood sheeting that runs to just under the wing's trailing edge, and that strengthens the fuselage.

I built my first Spirit following the manual step by step. The only problem I encountered was when I drilled holes in the $\frac{1}{4}$-inch plywood for the wing hold-down screws. I hit one of the pushrod tubes and had to replace the pushrod housing. Well, I said I wouldn't do that again, but when I built the second fuselage, I did it again! So, when I built the next four planes, I waited to put the pushrods in until *after* I had drilled the holes!

I also had a hard time fitting the canopy frame to the molded pilot figure, so I left the figure out and glued the canopy directly to the frame. My first Spirit has a clear canopy, but after seeing Mike Havey's black model, I dyed my second model's canopy with black, liquid dye, which gave a dark, smoky tint. Really nice!



The Spirit 100 wing root for the advanced version is shown here. The flap will be hinged along the wing's bottom surface. The small balsa piece will contain flap linkage and will be capped with the $\frac{1}{16}$-inch plywood plate through which a $\frac{1}{4}$ x 20-inch nylon bolt will secure the wing to the fuselage.

WINGS

The wings are easy to assemble, but there's nothing in the instruction manual that addresses the unevenness of the bottom, inboard ends of the main spars. The unevenness is caused by wrapping the spar to reinforce the spar carry-through box. The instructions recommend that you wrap the spar with heavy thread or monofilament; I used unwaxed dental floss. After the wings have been completed, smooth the wrapped area over with a filler, such as Spackle, to make it look nice. (It won't be covered with balsa as the top of the spar will be.)

I was in a hurry when I built the second (advanced) wing, and I glued the tip-blocks on before I carved-in the undercamber. As a solution, I sawed almost through the tip-block with an X-Acto saw along the extension of the aileron hinge line. Then, I wedged a sliver of balsa into the saw cut and glued it with CA to give the proper downward deflection. This is much easier than carving a concave surface.

COVER AND CONTROL

Black, $\frac{1}{4}$-inch auto trim tape is used for the trim lines on both models. They're both covered with MonoKote,* and all the flying surfaces are hinged with it, except for the spoilers on the sport-wing version, where Scotch tape is used.

I'm using the new Ace* Micropro 8000 radio system in both planes. Wow! They're nice! The small size of the receiver allows the entire system to be mounted under the canopy. This is tricky in the sport version because the receiver and a micro-servo for the spoilers share the rearmost compartment, which is just in front of the

SPECIFICATIONS

Model name: Spirit 100
Manufacturer: Great Planes Model Mfg. Co.
Type: Sport or advanced R/C sailplane
Price: $99.95
Wingspan: 99.5 inches
Wing area: 946 square inches
Weight: 50 to 65 ounces.
Wing loading: 7.6 to 10.0 ounces per square foot
Length: 51.5 inches
No. of channels req'd: 2 or 3 for sport; as many as 6 for advanced
Radio used: Ace Micropro 8000
Airfoil type: Selig 3010 for sport; Selig 7037 for advanced—no washout in either wing
Wing construction: Built-up balsa, basswood, plywood
Kit construction: Built-up balsa, basswood, plywood
Optional accessories: Spoilers, ailerons, and flaps

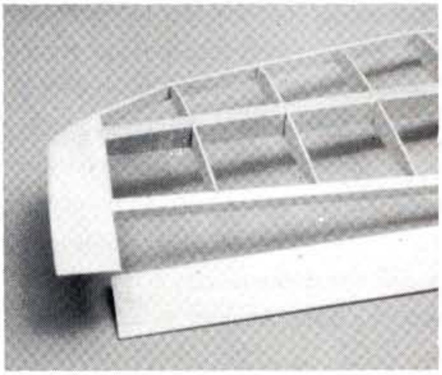
Features: High-quality precision-cut wooden parts, step-by-step fully illustrated instructions, full-size computer-drawn plans, clear canopy and hardware.

Hits
- Based on the award-winning, 2-meter Spirit sailplane
- Kit can be built with either of two airfoils
  —Sport wing with Selig 3010 airfoil
  —Advanced wing with Selig 7037 airfoil
- Four-position tow-hook
- Built-in ballast box that holds up to 2.25 pounds of lead (considerably enhances high-speed performance)
- Outstanding flight performance

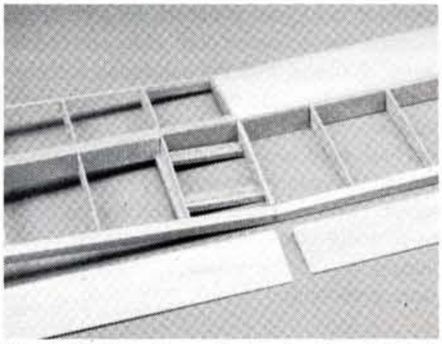
Misses
- Flap linkage as shown on the plans drives both flaps with a single servo, but the flaps do not track together through the full range of motion.

wing's leading edge.

The sport version uses only three channels and three microservos. The advanced-wing version has three servos in the wing (one for each aileron and one for both flaps), plus two servos in the fuselage. I plan to put another servo in the wing so that each flap will have its own servo. Then, I'll have the camber-changing ability plus differential flaps, which the Ace Micropro 8000 radio permits. How did we ever fly R/C without computer radios?



The Spirit 100 advanced-wing tip is wide enough to prevent aileron flutter, and it incorporates the triple-tape leading edge that's popular with modern, high-performance sailplanes.



The Spirit 100 advanced wing has less dihedral and a thinner airfoil than the sport wing, and it has a 1/16-inch camber. The aileron servo is mounted on a 1/16-inch plywood plate, which is then secured to the balsa-wood cross-rails shown between the ribs.

I'm very impressed with the Spirit 100 sailplane. I enjoy flying both versions and am seriously considering switching to this design from one I've flown since 1974. The well-designed, rugged, durable Spirit 100 flies really well. It's a better plane than I am a pilot.

**Here are the addresses of the companies mentioned in this article:*
Great Planes Model Mfg. Co., *P.O. Box 788, Urbana, IL 61801.*
MonoKote; *distributed by Great Planes Model Distributors, P.O. Box 9021, Champaign, IL 61826.*
Ace R/C Inc., *116 W. 19th St., Box 511C, Higginsville, MO 64037.* ■

HORNET

(Continued from page 35)

servo leads that go to the receiver have to be connected before the wing is attached to the fuselage. With the airplane assembled, install the battery by removing the nose and making the two battery connections through the nose opening. No charge connections are provided because the battery pack should be removed after each flight to allow it to cool before it's recharged.

The plane should now be covered and the other details added. After covering, check to be sure that you have 2 degrees of washout at the wing tips.

PREPARING FOR THE TEST FLIGHT

Make three important checks before you go to the flying field:

• **Check the CG.** Adjust the position of the battery pack until the plane balances as shown on the plans. Hold the pack in position with foam blocks.

• **Range-check for interference.** Either have someone hold your plane on the ground or secure it with a bungee cord while you check the radio system with the transmitter antenna collapsed. Operate the throttle while you walk around the plane 30 to 40 feet away, and look and listen for signs of interference. I had interference. I resolved it by replacing the receiver with an RCD* receiver, and by supporting the last 15 inches of the receiver antenna in a plastic tube in a nearly vertical position on the fin.

(Continued on page 96)

HORNET

(Continued from page 94)

• **Choose the right prop.** The prop and the number of cells you have will determine the plane's maximum power. To ensure a good performance, you must have 50 to 60 watts of power for each pound of airplane. Use an ammeter to measure the current from the battery for several possible props. Calculate the power as follows:

• Power in watts = voltage x current
• Voltage = number of cells (approximately 1 volt/cell)
• Current = amps, measured at full throttle

For minimum weight on the initial test flights, I used 15, 900mAh cells and 10x8 two-blade wooden props. I measured 25 amps at full throttle, therefore:

Power in watts = 15 volts x 25 amps = 375 watts

At the measured flying weight of 6 pounds, this gives a power-to-weight ratio of:

$\frac{375}{6} = 63$ watts/pound

This is more than adequate but, of course, I knew I could throttle back once airborne.

FLIGHT PERFORMANCE

It was a calm October morning when I decided to make the first test flight. With its excellent power-to-weight ratio and wide landing gear, the Hornet tracked straight down our grass runway and lifted off in about 75 feet. Climb-out was very spirited, and only small trim changes were required. The plane has a very solid feeling, and it looks striking—just like the full-scale airplane.

I was a little concerned about stalling, because sharply tapered wings have a tendency to tip-stall. Apparently, the 2-degree washout does the job, because the Hornet stalled straight ahead with no tendency to fall off on one wing or the other.

Though the Hornet wasn't designed for pattern-type aerobatics, it is capable of aerobatics appropriate for this type of aircraft. On the second test flight, I managed a roll and a

(Continued on page 99)

HORNET

(Continued from page 96)

stall turn. As I accumulate more flight time, I will expand the envelope.

Landing was straightforward on both powered and dead-stick approaches.

The Hornet twin electric has both the sleek lines of the original deHavilland aircraft and its excellent flight characteristics.

**Here are the addresses of the companies mentioned in the article:*
Astro Flight, *13311 Beach Ave., Marina del Rey, CA 90292.*
Hobby Lobby, *5614 Franklin Pike Circle, Brentwood, TN 37027.*
Coverite, *420 Babylon Rd., Horsham, PA 19044.*
SeeTemp, *P.O. Box 105, Sussex, WI 53089.*
Williams Bros., *181 Pawnee St., San Marcos, CA 92069.*
Carl Goldberg Models, *4732 W. Chicago Ave., Chicago IL 60651.*
Future Flight, *1256 Prescott Ave., Sunnyvale, CA 94089.*
Jomar, *2028 Knightsbridge Dr., Cincinnati, OH 45244.*
Control Development), *9419 Abraham Way, Santee, CA 92071.* ■

FUN FLY

(Continued from page 49)

three teams—Team Crash, Screamin' Siemons and the Death Seekers—completed a touch-and-go. One team had the foresight to build a hanging wire into their craft just for this purpose, showing the kind of innovation such a contest generates!

Spin competition was arguably the most captivating round of this new event. Team Crash's plane, under the control of ace pilot Steve Luchaco, used nine-tenths of its altitude trying to recover from its demonstration spins! How many spins? The judges lost count.

As the basic maneuvers were completed (which proved the planes to be much more capable aircraft than anyone had anticipated), some off-the-cuff competition started. An opening between two large trees on the far end of the field formed a box that was to be flown through. Two planes made it through, one with a small sprig of needles trailing from its antenna wire. Another crashed in the trees, but its designer retrieved it and flew it again. The crowd roared.

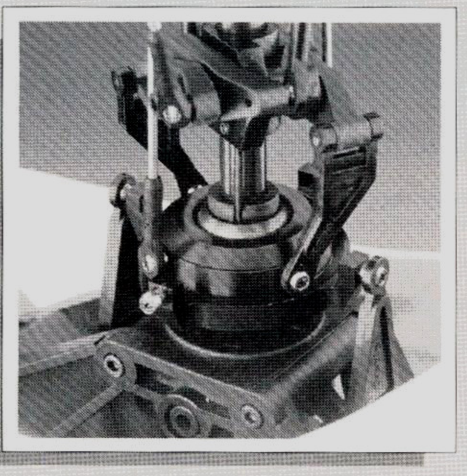
Finally, an all-up, last-down competition was flown. Some planes opted to stay high and conserve fuel, and others took a more combative approach. By this time, all the planes were showing the wear and tear of the competition, some a little soggy and one exhibiting a pronounced dihedral that hadn't been intended by its designers.

At the conclusion of the Connecticut Chal-

(Continued on page 106)

NEW HELI PRODUCTS

Descriptions of new products appearing on this page were derived from press releases supplied by the manufacturers and/or their advertising agencies. The information given here does not constitute an endorsement by **Model Airplane News**, nor guarantee product performance or safety.



GREAT PLANES
Concept 60 Metal Swashplate

The Kyosho Metal Swashplate for the Concept 60 offers tighter tolerances for a longer running life, using the screw-on Kyosho metal pivot ball. The black-anodized, machined-aluminum swashplate body offers the same degree of deflection as the original, plastic version.

Part no. KYOE8077

Price: $147.95

Great Planes Model Distributors, P.O. Box 9021, Champaign, IL 61826; (217) 398-6300.

HOBBY DYNAMICS
Digital Pitch Gauge

Hobby Dynamics introduces the ultimate in precise helicopter set-up equipment: the first, high-tech, easy-to-use pitch gauge that allows you to fine-tune your pitch. Its digital display reads to 1/100 degree, and it has a light, high-impact plastic case. It's a must if you're serious about R/C helicopter flying.

Part no. KSJ001

Price: $142.50

Hobby Dynamics Distributors (a division of Horizon Hobby Distributors), 4105 Fieldstone Rd., Champaign, IL 61821; (217) 355-0022.

MINIATURE AIRCRAFT USA
Zephyr Fuselage Kit

This kit fits X-Cell .30 and .40 mechanics and—with simple modifications—most other .30 helicopters. Its aerodynamic design uses the existing tail boom and has light epoxy construction, no-wood bulkheads, tinted windows and a complete mechanical enclosure. The tail boom and rear section are exposed. Assembly time is one hour.

Part no. 2517

Price: $119.95

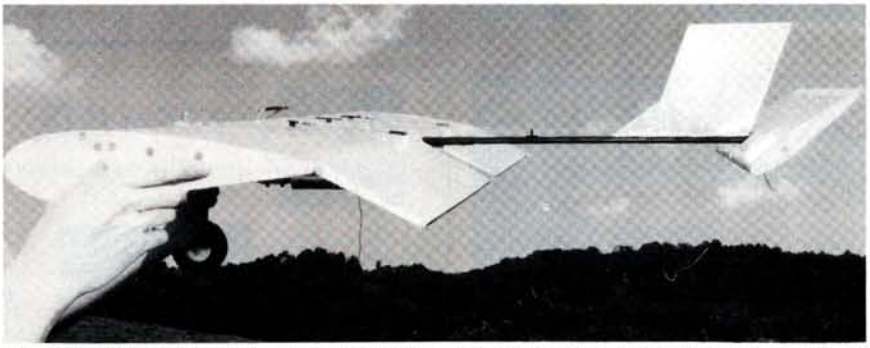
Miniature Aircraft USA, 2324 North Orange Blossom Tr., Orlando, FL 32804; (407) 422-1531.

SIMPLE PROGRAMMING

DAVID C. BARON

SETTING-UP FOR MAXIMUM AGILITY

HAVE YOU SEEN the latest competition fun-fly aircraft? They're surprisingly easy to fly, but people seeing them for the first time are sometimes intimidated by their outrageous control surfaces and throws. Overlooked are their wonderfully slow flying speeds and the crisp precision with which they perform. These airplanes only go exactly where they are told to. Pilots new to "Stick-It" designs first need to learn that they must be flown *slowly* (speed causes flutter, flutter eats servo gears, and this can lead to your engine eating dirt).



The new fun-fly airplanes use elevator-flaperon coupling to achieve extremely tight loops without snapping out. Although the ailerons drop to simulate flaps, full aileron control is maintained.

Many competition fun-fly kits and designs are advertised as not needing computer mixing, but when you see a plane perform first with and then without elevator/flap and flaperon coupling, you'll see that the improvement in performance with mixing is awesome. As a pilot, you'll also notice that the plane becomes easier to fly. For example, a stock "stick-type" aircraft can perform a 20-foot loop on elevator alone. Any attempt to tighten the loop will result in the plane snapping out of it. Add the right potion of mixed flaps, elevator and flaperons, and the same airplane will per-

REQUIRED FUN-FLY MIXES

Elevator/flap. Long ago, control-line stunt fliers realized the advantage to be gained from coupling the elevator to the flaps. When the flaps go down, the elevator goes up. With positive lift on the wing and negative lift on the tail, you will get a very tight loop!

Flaperons. In all the current competitive fun-fly designs, the control surfaces on the wing share the job of flaps and ailerons. This feature still allows the ailerons to work as ailerons while the flaps are in any position. This is a perfect example of bidirectional mixing. Neither control overrides the other; they just share the input signals and displace the control surfaces to the appropriate deflection. The deflection of the surfaces can look absurd when full aileron is added to full elevator/flap. Fortunately, looks don't make an airplane fly.

Flaperons are a preprogrammed mix in all the leading programmable radios. This means that they're already in the function list, and you need only plug the servos into the correct ports in the receiver.

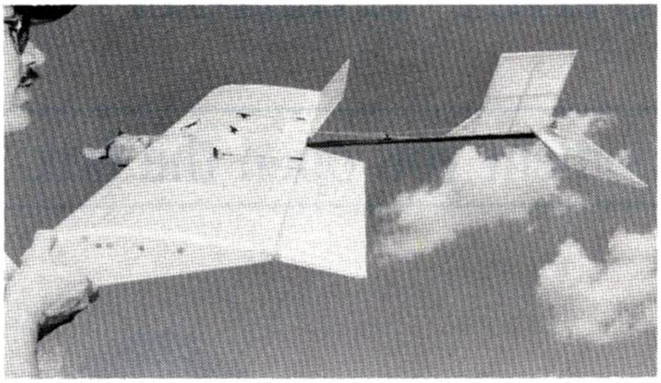
Spoilers or air brakes. The competition fun-fly fraternity has perfected a modified version of crow mixing. The aircraft are so light that landing to "stop the clock" can be difficult. The planes tend to float, so to lose altitude quickly, the ailerons (which are already flaps) are also coupled to the throttle as spoilers. When the throttle is reduced past a pre-set position, the ailerons are deflected upward as spoilers. I've seen these "spoilerons" rotate upward as much as 60 degrees to destroy lift over the wing.

Deploying spoilers causes an immediate, steep descent. It's very controllable because, although deflected upward, the control surfaces are still working full-time as ailerons. Because the flaps are coupled to the elevator, when your plane flares, they lower and cancel the spoilers. When the spoilers are cancelled, descent is stopped and forward motion begins again. You can land the plane in full spoiler, or, if the plane is descending too soon or too rapidly, you can manipulate the flare to move the aircraft forward. It's tough to overshoot a spot landing unless you've already passed the runway when you hit the spoilers!

TIPS FROM A COMPETITOR

With the Futaba 7UAPS, set the flap trim ("FLTR") function to 20 percent (see manual, page 20). You still want some flap trim capability, but only enough to work out minor flight-trim problems. Allowing too much authority will eventually cause trouble if the knob is inadvertently bumped.

Exponentials. If you're new to fun-fly aircraft and their incredible roll rates, you may find it advantageous to set your aileron exponential (see page 9) so that you get less throw around the middle half of stick deflection and maximum throw only at maximum stick deflection. This is preferable to using dual rates. I suggest a value of -20 percent. Note that the dual-rate switch allows you to set up two different ranges of exponential. This is one of my favorite features of the 7UAP series.



Here, down-elevator is coupled with reverse flaps, even as a right roll command is fed to the ailerons. Compare the aileron deflection with that shown in the next photo.

form rock-solid, 5-foot loops anywhere you want them.

In many ways, the new fun-fly airplanes evolved because of the availability of programmable radios. Even though they hardly look like any conventional airplane (more like 1/4-scale ultralights on steroids), their growing popularity is undeniable. We are witnessing a revolution—but why not? Never before has there been so much simplicity coupled with so much performance.

In this column, I discuss the basic programming mixes for fun-fly aircraft and show you how to set up such an aircraft using the Futaba* 7UAPS. In the next installment, I'll look at ways to program these mixes using radios from other manufacturers. Even if you are not a fun-fly airplane buff, it's worth your while to see how these mixes are achieved; you may want to experiment and use some of them.

MIXING SET-UP, PART I

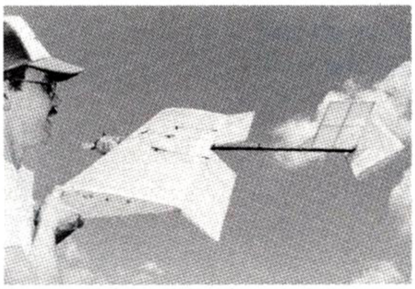
If you become confused during any of my programming steps, refer to your radio's manual. It does a good job of explaining how to set up the different mixing steps, as long as you know what you want to achieve by the mix.

Manuals too often lack explanations of and possible applications for each of the mixes—the "why," "where" and "when" to use them! That's where I hope to be of help.

First, install all your servos and connect all the controls. You need to be able to watch the control surfaces move while you set up the programming. Plug the two aileron servos into ports "1" and "6," respectively, in the receiver. The elevator is port "2," throttle is "3," and rudder (if used) is "4."

Enter the edit display mode of your transmitter by depressing the two "Mode Select" buttons simultaneously. Be sure to follow the order of mixes presented.

If your radio is new, or you're using a previously unused model memory, continue with the "+" Mode Select button to "REV" (reversing).



The ailerons are again deflected for right roll, but here, up-elevator is coupled with flaps. Aileron control is maintained, but both ailerons are deflected downward.

If you're using a model memory that's old and you wish to program over it, I recommend that you first go to the "PARA" (parameters) function and cursor until you get to "RSET" (reset). Depressing both Data Input keys simultaneously will return that model memory to the factory presets. Now continue with the Mode Select "+" key to "REV" (reversing function).

Reversing. It saves a lot of time if you set up this function first. Move your transmitter controls, and note that only one aileron moves. This is normal, but we still want to make sure it is going in the proper direction. Reverse as necessary and check all of the other control surfaces and throttle. Ignore the flap channel for now. It can be reversed if necessary when we're in the "flaperon" section.

Fail-safe (F/S). This is up to you. Most fun-fly designs are flown close in and low so that none of the "pre-sets" or "holds" will make a lot of difference. The only exception would be having the throttle go to idle to warn you of interference.

Flaperons. With the Mode Select "+" key, scroll to FLPR (flaperons). Turn on flaperons by switching the flashing INH (inhibit) to "On" with the "+" Data Input key. Now, both ailerons should move when the transmitter stick is moved. Do they travel in the correct direction? If they don't, they will probably move together in the *same* direction.

If reversing is necessary, move through the function with the cursor key until you get the channel-6 Direction of Operation mode. This is noted by the "+" or "-" flashing in front of the "100" (in the lower right corner of the display). Use the Data Entry key to change direction as necessary. Recheck the direction of throw after making each change.

Next, manipulate the flap-control knob on top of the transmitter. Both flaps should drop or rise in unison. If they don't, go back into the Direction of Operation mode described in the previous paragraph. If there's still a problem, you'll have to return to the REV (reverse) function and change the channel-6 direction.

ELEVATOR/FLAP- vs. SPOILER-MIX CONFLICT

Both of these "built-in" mixes are actuated by the same switch on the front of the transmitter, so one of them can't be used. This is not a serious problem because the Programmable Mix functions (PMX-1 and PMX-2) can be manipulated to do a good, if not better, job of providing the elevator/flap mixing. This is because using both PMX mixes allows for independent manipulation of the left and right flap throw. This is vital for fine-tuning loops.

Another reason for using the PMX mixes for the elevator/flap coupling is that you always want this coupling "on" every time you fly. It's possible to defeat the programmable mixing switch (no. 6 on page 50) so that you never have to worry about accidentally attempting a loop touch-and-go with the elevator/flap coupling turned off! This would be a disaster! Defeating the program-

(Continued on page 120)

FUN FLY

(Continued from page 99)

lenge, Team Crash was the victor. They had shown consistency from design through flight competition and had vanquished their foes with grace.

Word has it that a variation on this event will be held at the 18th annual Kingston Fun Fly in 1993. If you're interested in attending, and I recommend that you do, write to Rolly Siemenson, 223 Glen Castle Rd., Kingston, Ontario, Canada K7M 4N7, for further information. You're guaranteed to have a great time!

RPM

(Continued from page 82)

tion measurements showed 1.8 fluid ounces per minute at peak horsepower (19,000rpm).

The scary thing about our flight testing is that it was a relatively poor day for engine performance—warm, with low pressure and high humidity. Calculations showed that air speeds could be expected to be about 3 percent higher on a "normal" day!

HITS

Thinking back to the early '70s, our Formula 1 Super Tigre X-40s produced about 2.70b.hp on the dyno, using 65-percent-nitro fuel. Torque peaked at about 18,000rpm and b.hp at about 25,000. Prop selection was critical and pylon times were in the mid-1:20s. The Nelson 40Q matches these performance figures with low rpm peaks for both torque and b.hp—and it has flat curves! A prop of just about any size (within reason) will function well, and the engine is a pussycat to handle. All this on 15-percent-nitro fuel!

MISSES

All this performance comes at a price—$325 per item. Other relatively minor dislikes were the special-size glow plugs that wouldn't allow me to use my head-lock booster cable and the relatively high noise levels.

And there you have the first RPM column. What do you think of it? Comments and suggestions for making it better are welcome. Just write to me care of *Model Airplane News.*

**Here are the addresses of the companies mentioned in this article:*
***Condor Hobbies**, 1733-G Monrovia Ave., Costa Mesa, CA 92677; (714) 642-8020.*
***Nelson Competition Engines**, 121 Pebble Creek Lane, Zelienple, PA 16063; (412) 538-5282.*
***Rev-Up;** distributed by Progress Mfg. Co., P.O. Box 1306, Manhattan, KS 66502.*
***Master Airscrew;** distributed by Windsor Propeller Co., 3219 Monier Circle, Rancho Cordova, CA 95742.*

Propeller Selection, Part 2

An Analytic Approach

by ANDY LENNON

PART ONE OF this two-part series concluded partway through a discussion of the effect a model's design has on propeller selection. This article continues on the same subject, offers a recommended method for selecting the best prop, and describes some basic propeller effects.

The Swift uses a power loading of 200 ounces per cid.

THE MODEL'S AERODYNAMIC DRAG

A "clean" model such as the Swift will offer much less air resistance than one with an exposed engine, large flat windshield, large round or rectangular (in cross section) wheels, unfaired landing-gear legs, dowels and rubber bands for wing-to-fuselage attachment, and other "built-in head winds."

Parasite drag increases in proportion to the square of the speed. Doubling the speed results in a fourfold drag increase. High drag means increased "slip" (the prop will operate at higher angles of attack) and rpm and flying speed will suffer adversely. Lower pitches and larger diameters are appropriate. While Figure 6 (Part 1) does not reflect the impact of high drag, it will put you "in the ballpark" as far as rpm and pitch are concerned.

POWER LOADING

A large engine powering a small, light model will obviously outperform a heavier, larger model powered by a smaller engine.

With the large variety of both models and engines available, some simple way of establishing the "weight-to-power ratio" is needed to permit ready comparisons.

One way is to calculate what the weight in ounces would be if both engine and model were scaled up (or down) in proportion to 1 cubic inch of engine displacement (cid). For example, the Swift is powered by an O.S. Max .46 SF engine, and weighs, fueled, 92 ounces. Its weight-to-power ratio is $^{92}/_{0.46}$—or 200 ounces per cid.

Another example is of a model weighing 300 ounces, powered by a 1.2cid engine. Its power loading is $^{300}/_{1.2}$ or 250 ounces per cid.

This comparison has obvious limitations. It assumes that power output of various sizes and makes of engines is proportional to their displacements—this assumption isn't too far off the mark. It's invalid for comparing 2-stroke with 4-stroke engines. Each class must be separately evaluated (i.e., 2-strokes should be compared with 2-strokes, or 4-strokes with 4-strokes).

Experience indicates that 2-stroke models with a 200-ounce per cid power loading that are well "propped" will have excellent performance. Higher power loadings, up to 300 ounces per cid, will result in diminished, but still acceptable, performance.

PERFORMANCE

In designing a model, selecting a kit to build, or choosing a model to scratch-build from magazine plans, the modeler has performance objectives in mind that probably reflect his or her flying skills. The design goal may range from a slow, stable, easy-to-fly airplane (for a beginner) to a fast, high-powered, aerobatic model (for the expert).

For the beginner, low wing loadings and a

TO CHOOSE A PROP

This procedure is recommended for selecting propellers for your model:

1. For a given coefficient of lift and wing loading, find the estimated air speed as indicated in the nomograph (Figure 5) in Part 1 of this article. Increase the speed by 25 percent to allow for climbing and any appropriate aerobatic maneuvers (e.g., convert a 50mph estimate to 63mph).

2. Look at the rpm/speed/pitch chart (Figure 6) in Part 1 of this article, and pick out a pitch and rpm that will give you the air speed you want.

3. Look at a published evaluation of the engine you are flying and see the reported rpm for various props tested on the engine. Also look for the rpm range where torque is maximized, if this information is provided. Pick a few props that provide rpm within the high-torque range and achieve the desired speed range.

4. Test these props at the flying field and stick with the one that provides the best performance.

higher weight-to-power ratio of 275 to 300 ounces per cid would be in order.

At the other end of the scale, consider the Swift. Designed as a sport model with a wing loading of 22 ounces per square foot of wing area, a power loading of 200 ounces per cid and with the least drag that could be reasonably expected—short of retracts—it is fast, maneuverable and fun!

It's flown with two propellers, both Landing Products* APCs. The first, a 10x9, has a static rpm of 12,000. The second, a 10x10 (a "square" prop) turns 11,000rpm static.

From Figure 6 in Part 1, level flight speeds are estimated to be 98 and 100mph—very close! This model's vertical performance is that of a "homesick angel"; it performs vertical eights with ease and grace. Fuel was Omega* with 5 percent nitro.

ENGINES

Today's model aircraft engines are fine examples of modern engine technology and precision machining. Most are "oversquare"—the bore diameter is larger than the stroke. This author prefers 2-stroke engines because they're simpler, more rugged, lighter, more powerful and less costly than the 4-stroke versions of the same displacement.

Engine-evaluation articles, such as those by David Gierke and Mike Billinton in *Model Airplane News*, and Clarence Lee in *R/C Modeler*, provide performance data on currently available engines and insight into their design and construction. They provide tabulations of static rpm of an engine while it is powering various diameters and pitches of propellers.

Table no. 1 shows Billinton's recording of rpm for the Fox Eagle 74 (*Model Airplane News*, October '91) and Table no. 2 that of Lee for this engine. (*R/C Modeler*, March '91). In addition, Billinton provides performance curves of the 74 in Figure 7. Note that with silencer and standard .330 carb, the brake horsepower (b.hp) peaks at 15,000 rpm, and the maximum torque is in the 7,000 to 11,000rpm range.

Data of this type, and the engine manufacturers' recommendations, provide very useful guides in selecting the diameter to match the pitch and rpm determined from Figures 5 and 6 in Part 1.

MATCH THE PROP

As previously noted, for a 20-ounces-per-square-foot wing loading, a 55mph speed is indicated, and a 6-inch pitch prop turning 10,000rpm is one possible selection. Look at Tables 1 and 2 for the Fox Eagle 74. A 14-inch diameter by 6-inch pitch prop would turn at around 10,000 to 11,000rpm. Figure 7 indicates that these rpm aren't too far off the peak of the torque curve for this engine. Another choice could be a 12x8 prop also turning in the 10,000 to 11,000rpm range. Like low gears on a car, the lower pitch of 6 inches would provide quicker acceleration and better climb, but lower top speed.

TOOLS

There are two items of equipment every serious modeler should possess. First is a photocell tachometer, either digital or analog, to measure the static rpm of your engine. It is useful to compare the performance of props of various diameters and pitches with the published data as described above. These tachometers may be used safely from behind the prop, and they aren't expensive.

The second tool is a propeller balancer, the type with two sets of overlapping, free-turning disks. Balance every prop—you'll be surprised how many require balancing—to avoid vibration.

On reinforced plastic props, a coat of silver paint (after a gentle surface roughing with fine sandpaper for better paint adherence) will aid the photocell to "see" the prop—and also make that dangerous prop more visible. Any imbalance is easily corrected by adding paint on the lighter blade.

TABLE 1

Prop. diameter, pitch and make	RPM
18" x 8" Top Flite	5,190
15" x 8" Graupner	7,700
15" x 8" APC	8,030
16" x 5" Zinger	8,078
14" x 8" APC	9,180
13" x 6" MK	11,040
12" x 6" APC	12,814
11" x 5" Top Flite	13,960

Mike Billinton's evaluation of the Fox Eagle 74 with various names, diameters and pitches of propellers.

TABLE 2

Prop. diameter and pitch	RPM
11" x 8"	12,200
11" x 10"	10,900
12" x 6"	12,100
12" x 8"	11,000
12" x 10"	9,000
13" x 6"	12,450
14" x 6"	10,150

Clarence Lee's evaluation of the Fox Eagle 74 with various diameters and pitches of Zinger props.

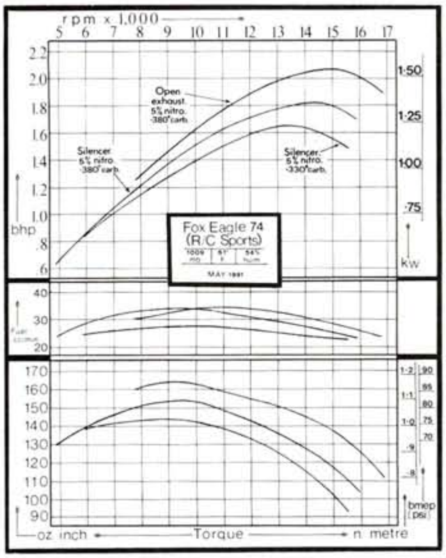


Figure 7

FLIGHT TESTS

All this will narrow the choice to two or three props. However, there is just no substitute for actual flight tests in your final selection to obtain the performance sought and the optimum output of prop and engine.

PROPELLER MATERIALS

Props are available in wood, nylon and reinforced plastics. This author favors the reinforced plastic props because of their ruggedness and efficiency, even though they weigh roughly twice the weight of their wooden equivalents. Avoid unreinforced nylon props; they lack rigidity for use on high power.

PROPELLER EFFECTS

As mentioned in Part 1, these are:

- Slipstream
- Asymmetric blade effect
- Pitching moment
- Torque
- Gyroscopic precession

Slipstream. The slipstream (see Figure 1, Part 1) moves as a helix rotating around the airplane in the same direction as the propeller's rotation, but at higher than flight speed. It strikes body, wing and tail surfaces at angles and increases the drag of any obstacle in its path. Its most unfavorable impact is on the vertical tail surface—it causes yawing that calls for rudder-trim correction.

The increase in the velocity of the oncoming relative wind (i.e., ahead of the prop) reduces the prop's effective pitch, as does one blade's downwash on the next. Such downwash further reduces the prop's efficiency. The situation is made worse with

three or more blades. For model airplanes, such multi-bladed props aren't recommended, except for scale models of aircraft so equipped.

In full-scale aircraft, multi-bladed props are used to absorb the high power of modern piston and turboprop engines. They also reduce the propeller's diameter so as to avoid compressibility effects from tip speeds close to the speed of sound. The loss of efficiency in this reduction must be accepted.

Asymmetric Blade Effect. When the plane of the propeller is inclined to the direction of flight as in Figure 8, the advancing blade operates at a higher angle of attack than the retreating blade. Thrust on the advancing side is higher than on the retreating side. This causes a pitching or yawing couple.

Pitching Moment. When the thrust line is tilted as in Figure 9, a vector is introduced that causes a pitching moment. It may combine with the asymmetric blade effect.

left (for props rotating clockwise, viewed from behind) that could result in a ground loop unless corrected by rudder action.

The author's flying-boat design, Seagull III, was initially flown with a Graupner 11x8 prop that was mounted in a pusher configuration with the propeller's plane of rotation directly over the center of gravity (the thrust line was 6 inches above that CG). Coming out of a left-hand turn, the model would enter an uncommanded, gentle right-hand turn, nosing down slightly. It was easily corrected, but annoying.

Replacing the Graupner (an excellent prop) with a Zinger wooden equivalent of half the Graupner's weight eliminated this peculiarity.

NOISE

Many clubs are experiencing problems from noise that originates from two sources: the engine itself and the propeller.

Engine mufflers and tuned pipes now available go a long way to reduce engine noise to acceptable levels.

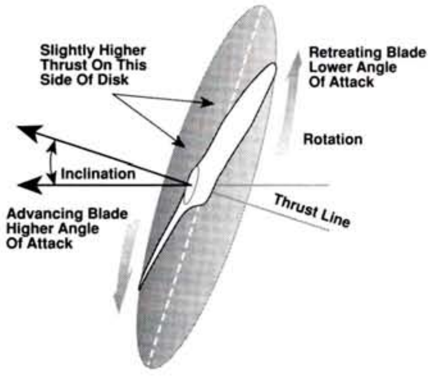


Fig. 8 Asymmetric Blade Effect

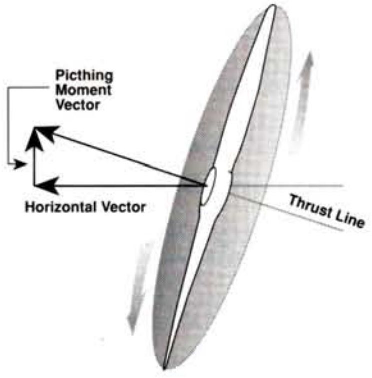


Fig. 9 Propellor Pitching Moment

Torque. The resistance to rotation caused by the prop's drag tries to rotate the whole airplane in the opposite direction. This is particularly true in a steep climbing attitude at low forward speed and maximum rpm where the prop is operating at high angles of attack, such as just after liftoff. A touch of opposite aileron input may be needed to offset the torque.

Gyroscopic Precession. Like a gyroscope, a rotating propeller resists any effort to change the direction of its axis. The heavier the propeller and the higher the rpm, the greater this resistance. If a force is applied to tilt the plane of the prop's rotation, it is *"precessed" 90 degrees onward, in the direction of the prop's rotation.*

This effect shows up markedly on taildragger takeoffs if the tail is lifted too soon and too high. Precession causes a yaw to the

Regarding prop noise, there's a trend to long-stroke engines that develop their highest torque at lower rpm so that, for example, they can swing props with increased pitches. Higher pitches and lower diameters reduce tip speeds and prop noise. Propellers with pitches equal to their diameter or greater (over square), such as 11x11s, 11x12s, 11x13s, or 11x14s, are now widely available.

It's hoped that this series on propeller selection has been informative and useful. Good luck and happy flying!

**Here are the addresses of the companies mentioned in this article:*
***Landing Products,** P.O. Box 938, Knights Landing, CA 95645.*
***Omega Fuel;** distributed by Morgan Inc., P.O. Box 1201, Enterprise, AL 36331.* ■

PROGRAMMING

(Continued from page 104)

mable mixing switch is done in the MXSW function. This is in the "PARA" list. (Refer to page 22 of your manual.)

PMX-1 AND PMX-2

We need to use both PMX-1 and PMX-2 because the programmable mixes address the control surfaces only through the port in the receiver into which the particular surface's servo is plugged. We will be assigning the elevator servo as "master" in both of the PMX's. The "slave" channel on PMX-1 will be channel 1, and the "slave" channel on PMX-2 will be channel 6.

Refer to page 11 of your manual. Scroll with the Mode Select key until you reach PMX-1. Use the Data Input keys to switch from INH (inhibit) to "on." If "off" becomes visible, flip switch 6 (the program mix switch) on the top right of your transmitter.

Use the cursor keys to arrive at the master channel selection (channel 2, elevator).

Use the cursor keys again to arrive at the slave channel selection, and set this for channel 1. Move your transmitter stick and verify that flap no. 1 moves when you move the elevator. You want it to go down when the elevator is up, and vice versa. If it doesn't, move the cursor to the next data setting, which will be "mixing servo direction." This is designated by the "+" or "-" flashing before the number in the lower right corner of the display. If the flap has to be reversed, hold the elevator stick on the transmitter at full "up" and depress the "-" Data Input key. Now hold the stick "full down," and, if necessary, depress the Data Input key to make the flap go up.

Use the cursor keys to get to the next data setting mixing rate. This is the amount of throw the flaps will have when the elevator stick is moved.

Pull the elevator stick to full "up," and note the angle of deflection of the elevator and the flap. Set the deflection of the flap throw to approximately half that of the elevator.

There are two reasons for this:

- The flaps create more drag than lift and, with too much deflection, they will hurt instead of help the looping capability of your aircraft.
- Unless you use a heavy-duty elevator servo (one with at least 70 ounces of torque), your flaps might cause a pitch change that your elevator is not powerful enough to overcome. This has destroyed many "stick" aircraft on their first flights!

Now, scroll to the PMX-2 function with the Mode Select "-" key, and repeat all, except that the slave channel in PMX-2 will be channel 6.

(Continued on page 130)

Bud Davis of Redwood City, CA, scratch-built this 1/3-scale Piper L-4 Grasshopper from Bob Neles/Ken Runestand plans. The WW II observation aircraft weighs 32 pounds and has a 12-foot wingspan. Power comes from an O.S. 240 4-cylinder engine.

ON FATHER'S DAY weekend (June 20 to 21), the beautiful Woodland-Davis Aeromodelers f scale 4-stroke competition without the pressure The number of contestants wasn't particularly no were judged on the realism of the event certainly was. their first scale meet.

WH

Evan Wolfe, a local attorne sound, and he did the behi aren't all bad!) Evan has be

4-StrokeScale Fly-In

by JERRY NELSON & ED WEBER

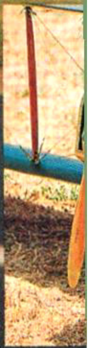
Sounding as good as they look

Large photo and left: Northrop Gamma 2B is readied for another flight. Dave Lovitt checks throttle response as Jeff Lovitt holds on.

Earl Thompson of Livermore, CA., wheels his Gloster Gladiator back to the pits after an aborted take off attempt. The model is powered by an Enya 240 "V" twin, weighs 17pounds and has a wingspan of 76 inches.

Rodger Grotheer of Carmichael, CA, flew this Monocoupe 90A and powered it with an O.S. 1.20. Built from an Ikon N'Wst kit, the model weighs 14 pounds and has an 8-foot wingspan

Gary Par this bea engine, inches.



y competition was held at A, area). The event offered MA precision scale events. ovel concept (e.g., planes engines) and the success onsidering by any club for

T?

lea of judging the models' izational work. (Attorneys e of 4-stroke engines for scale models for a long time, and he always tries to get more modelers into scale competition. The name of the competition—Scale Fly-In and Exhibition—set the tone of the meet. Evan and his coworkers got several sport modelers to enter the competition as their first scale meet.

(Continued on page 76)

Denny Lupcho of Grass Valley, CA, entered this beautiful model of the Travelair Mystery Ship built from a Fred Reese Golden Age kit. The 10-pound model is powered by an O.S. 1.20 engine and has a wingspan of 70 inches. Denny won 1st place Static only.

Forrest Edwards' scratch-built Polikarpov PO-2 comes in for a landing. The 30-pound model performed beautifully.

Gary Randolph of Newcastle, CA, starts his Waco SRE. The 20-pound model is powered by a Saito 270 engine and has an 85-inch wingspan. The plane was scratch-built from U.S. Quadra plan.

d place Static only with owered by a Laser .75 d has a wingspan of 89

Gene Hughes of Sacramento, CA, brought this Byron Pitts S-1A. It's powered by an O.S. 240 FS engine. The model weighs 20 pounds, 2 ounces, and it has a wingspan of 68 inches.

PHOTOS BY STEVE DUNHAM

They come in different sizes (too many to list in this space!), and one is bound to meet your needs.

We couldn't find any information on the other planes you mentioned, but maybe a reader will come forth with the name of a supplier. "Flying Model Warplanes" (no. BKP-07911) is offered in the "Buyers' Mart" at the back of this issue. GY

TEACHERS CAN INSPIRE R/C INTEREST

If young people are going to enter this hobby, then it's up to us to help them. Today, kids face more obstacles than many of us did when we were growing up. I don't believe that the ARF explosion or the "tremendous popularity" of R/C cars is keeping kids out of our hobby; neither is the cost nor the initial complexity of R/C equipment.

Kids often have access to more money than our generation did (I'm 44), and many ARFs are well within their reach. Most kids are well acquainted with the complexities of electronic equipment, e.g., computers, stereos and VCRs. (If you want your VCR programmed, ask a kid to do it!) And remember, R/C car radios are just as complex as those used for model aircraft. R/C cars are stepping stones toward R/C aircraft. (I have my students use one to overcome left/right disorientation.) Many of us started in free flight or control-line and graduated to R/C when the technology became more user-friendly, or when we had jobs and could afford it.

It's important to consider both how and why many of us were introduced to this hobby. Most of us had nuclear families; our dads worked during the week (on weekends they "played"—with model airplanes, of course!) and our moms stayed home. Most of us were introduced to model aircraft by our dads. They lived through—perhaps even served in—a war in which aviation played an important role. It was also a war that received much support in this country.

Today, kids spend much less time with their families. Many live in single-parent households or in households where both parents work. They spend a lot of time entertaining themselves—their lives saturated by movies, video games, jobs,

(Continued on page 10)

PROGRAMMING

(Continued from page 120)

SPOILER SET-UP

Scroll with the "+" Mode Select switch to ABRK (air brake or spoiler). Switch from INH to "on" with the Data Input key. Check that the 6-2 switch (switch no. 7 on page 50) is down ("on" position). Use the cursor keys to arrive at the channel-1 throw setting. Set the rate with the Data Input keys; to start, I suggest 40 percent.

Use the cursor keys to arrive at the channel-2 throw setting. Leave this at zero until you have a chance to see whether your plane needs up- or down-elevator trim when the spoilers are deployed.

Use the cursor keys to advance to the channel-3 (throttle) mode setting. I recommend that you use the linear setting, which is switched on with the "+" Data Input key. This will allow the throttle-stick position to actuate the spoilers.

Use the cursor keys to arrive at the channel-6 throw setting. Again, I recommend 40 percent.

Last, use the cursor keys to set the throttle cutoff point. This is designated by the word

(Continued on page 136)

CLASSIFIEDS

RATES: non-commercial— 25 cents per word. No charge for name and address (no commercial ads of any kind accepted at this rate.); commercial— 50¢ per word (applies to retailers, manufacturers, etc.); count all initials, numbers, name and address, city, state, zip code and phone number. **All ads must be paid for in advance.**

To run your ad for more than one month, multiply your payment by the number of months you want it to run. Deadline: the 10th day of the month, e.g., *January 10 for the April issue.* We don't furnish box numbers, and it isn't our policy to send tear sheets. **SEND AD AND PAYMENT TO: CLASSIFIED ADS, Model Airplane News, 251 Danbury Rd., Wilton, CT 06897.**

R/C WORLD—ORLANDO, FL, CONDO RENTAL—2 bedroom, furnished. Available weekly or monthly. Low rates, 100 acre flying field with enclosed hangar. Swimming pool, tennis courts on site. Minutes from Disney World and Epcot Center. For information, call Micki at (800) 330-7243 or (407) 260-1252; fax (407) 331-3867; or write to: Page One Management Realty Inc., P.O. Box 4732, Winter Park, FL 32793-4732.

OLD-TIMERS, take a ride back in time to airplane modeling roots with this vintage book—*Gas Models.* A true collector's book from the early editors of *Model Airplane News*, it contains the best of modeling from the '30s and '40s, including great technical information and classic construction articles from the Golden Age period. $7.95, add $3 S&H for first item; $1.50 for each additional item. *Foreign:* (including Canada and Mexico)—*airmail*, add $7.50 for first item, $4.00 for each additional item. Payment must be in U.S. funds drawn on a U.S. bank, or by international money order. (Connecticut residents add 6% tax; Canadian residents add 7% tax.) Air Age Mail-Order Service, 251 Danbury Rd., Wilton, CT 06897.

RUN A GASOLINE FUEL MIX in your ignition-converted ST 25000 & 3000 and O.S. BGX-1. Complete kit with new Walbro carb, $59.95. Protect your valuable airplane from ignition noise problems. New Bosch resistor spark plug cover. Works on all magneto and CDI systems, $9.95 (plus handling). Send $1 for price brochure and newsletter on many ignition parts. C&H Electronics, P.O. Box 1732, Riverton, WY 82501; (307) 857-6897. [12/2]

IMPORTED DIESEL ENGINES—world's best selection: AE, AM, Aurora, Cipolla, KMD, MAP3, Mikro, MK-17, MVVS, Modela, PAW, Pfeffer, Letmo and USE diesels, plus very special imported glow engines, CO_2 engines and sailplane kits. Ten-page catalogue, $1. Carlson Engine Imports, 814 E. Marconi, Phoenix, AZ 85022-3112. [12/2/4/6]

PLANS ENLARGED—Scanning/Plotting Services, CAD/Printer Plotter Software, Free Information. Concept, PO 669E, Poway, CA 92074-0669; (619)486-2464. [12]

CARBON FIBER—100 ft. 12k tow . . . $9.95 plus $2.00 S&H, to Discount Composites, P.O. Box 13, Bountiful, UT 84011-0013. [12/1/2/3]

VACUUM FORMING—Now in its third printing, the most comprehensive book on vacuum forming ever published for the hobbyist. 128 pages of hands-on information show how easy it really is to make your own plastic parts. Includes exclusive information on an easy-to-build 2-stage vacuum system for truly professional results. It's easy! Try It! $9.95 + $1.05 postage. Vacuum Form, 272B Morganhill Dr., Lake Orion, MI 48360; (800) 737-3000. $1 surcharge for Visa/MC. [12/1]

WANTED—Toy metal outboard boat motors, chrome-plated airplane ashtrays, tin toy airplanes. Gronowski, 140 N. Garfield Ave, Traverse City, MI 49684-2802. [12]

CESSNA 150 giant-scale kits from Custom Cutters are now available! Complete kit using Hostetler's plans; 10' span, $475, including shipping. SASE, or call for brochure or order. 4302N 750W, Ligonier, IN 46767; (219) 894-3370. [12]

R/C REPORT MAGAZINE'S ENGINE TESTS BOOK—Over 60 reviews. Many direct comparisons of similar engines. Includes accurate measurements, honest performance ratings, and candid reviewer opinions. Just $9.95 + $1.75 S&H. Free sample magazine included! R/C Report, Box 1706-M, Huntsville, AL 35807. [12,1,2]

WANTED: Model engines and race cars before 1950.Don Blackburn, P.O. Box 15143, Amarillo, TX 79105; (806) 622-1657. [12-5/93]

WANTED: Berkely and Cleveland kits or related items; parts, plans, boxes, brochures, books, ads, radio equipment, accessories, etc. Gordon Blume, 4649-191st Ave. S.E., Issaquah, WA 98027. [12]

WANTED: your old proportional radios; interested in pre-1980, American made; C&S, Deans, Klinetronics Spar and others. Older is better. Ron Gwara, 21 Circle Dr., Waverly, NY 14892; (607) 565-7486. [12-3/93]

WANTED: Old, unbuilt, plastic model kits. Planes, military, figures, cars, promo. Aircraft or missile desk models. Send list, price. Models, Box 863, Wyandotte, MI 48192. [12-9/93]

ENGINES: Ignition, glow, diesel. New, used, collectors, runners. Sell, trade, buy. Send $2 for large list. Rob Eierman, 504 Las Posas, Ridgecrest, CA 93555; (619) 375-5537. [12]

ANTIQUE IGNITION AND GLOW PARTS CATALOGUE: 100 pages—timers, needle valves, original cylinder heads, point sets, drive washers, stacks, spark plugs, plans. Engines: Atwoods, Baby Cyclones, McCoys, Hornets, others. $8 postpaid, U.S.; $20 foreign. Chris Rossbach, R.D. 1 Queensboro Manor, Box 390, Gloversville, NY 12078. [12/1/2]

MAGAZINE BACK ISSUES—Flying Aces, MAN, Air Trails, 1930s and '40s. FM, RCM and more. Send SASE for list to: Carolyn Gierke, 1276 Ransom Rd., Lancaster, NY 14086. [12/1/2]

1930s to 1950s MODEL AIRPLANE MAGAZINES; 1930s aviation pulps—complete and good condition; $1 for list. Bruce Thompson, 328 St. Germain Ave., Toronto, Ontario, Canada, M5M 1W3. [12-4/93]

SCALE MODEL RESEARCH: Aircraft documentation. World's largest. Over 3,300 different Foto-Paaks and 20,000+ drawings. Catalogue—$4. 2334 Ticonderoga Way, Costa Mesa, CA 92626. [12-6/93]

SCALE DOCUMENTATION, plans enlarging; 140 super-scale, sport and giant R/C construction plans, three-views, cutaway drawings. Over 100,000 documentation photos in stock; 120-page catalogue, $5 ($10 overseas). Jim Pepino's Scale Planes and Photo Service, 3209 Madison Ave., Greensboro, NC 27403; (919) 292-5239. Visa/Mastercard. [12/1/3/5]

CONTACT OTHERS who love models! For fans, collectors and traders. Inexpensive! Send $1 for information and personal interest application. Club One, "M", 9955 River Rd., Petersburg, VA 23803. [12]

DISTRIBUTORS WANTED for a future R/C airplane dealer. Send information to T. Smith, 465 E. Paletown Rd., Quakertown, PA 18951. [12]

BALL BEARINGS for engines; high-performance, class 3/P6 with polyimide, phenolic, or steel retainers. Sold in sets or individually; SASE for price list: Revmor, P.O. Box 548, Palm City, FL 34990; (407) 283-6831 after 5. [12]

GIANT-SCALE PLANS by Hostetler. Send SASE to Wendell Hostetler's Plans, 1041 B Heatherwood, Orrville, OH 44667. [10/93]

START YOUR OWN HOBBY SHOP, or buy for friends or group; 30 or 60 percent off. For information, send $1 and no. 10 SASE to R&L Hobbies 10334 Portage Rd., Box MAN, Portage, MI 49002. [12]

INTERNATIONAL AIRCRAFT RESEARCH. Need documentation? Include name of aircraft for availability of documentation with $3 for three-view and photo catalogue. 1447 Helm Court, Mississauga, Ontario, Canada L5J 3G3. [12/1]

BUTTON-HEAD SHEET-METAL SCREWS—$2x2^1/_2$—$4.90 for 100; $4\text{-}40x^3/_4$ alloy socket caps—$4.75 for 100. New, lower prices on metric socket caps. Free catalogue. Contact Micro Fasteners, 110 Hillcrest Rd., Fleminton, NJ 08822; (908) 806-4050; fax (908) 788-2607.

P/C—THE EASY WAY to simulate metal panels; $1 gets information and sample. Clarke Smiley, 23 Riverbend Rd., Newmarket, NH 03857. [12]

CONTROL-LINE AND R/C kits cut on per-order basis. Send SASE to Repli-Kit, P.O. Box 1412, Inverness, FL 32651-1412. [12/1]

WANTED: model airplane engines and model race cars made before 1950. Jim Clem, 1201 E. 10, P.O. Box 524, Sand Springs, OK 74063; (918) 245-3649. [6/93]

HELICOPTER SCHOOL- 5 days of hands-on instruction with X-Cell helicopters and Futaba computer radios. Small classes tailored to your individual needs. Beginner to expert. Includes all meals and lodging. Over 225 satisfied students and 7,500 flights logged. Located on a 67-acre airport used exclusively for R/C training; owned and operated by Ernie Huber, five-time National Helicopter Champion and helicopter designer. Send for *free* information and class schedule *now!* R/C Flight Training Center, P.O. Box 727, Crescent City, FL 32112; (904) 698-4275; fax (904) 698-4724. [12.1]

USED ENGINES WANTED: ignition, glow, diesel. Send description and price for prompt reply. T. Crouss, 100 Smyrna St., West Springfield, MA 01089. [12]

COMPUTER DESIGN. Design models with CAD software. Review sampler, $11. Catalogue, $1. Complete IBM software line-graphics, business, scientific, games, Windows. State disk size. Vista-MA Software, 95106 Huaala Pl., Mililani, HI 96789. [12]

FOR SALE: original castings for no. 3 Atom. Need machining; four castings; drawings, $29.50. Joel Balsam, 4 Pickwick Hill Dr., Huntington Station, NY 11746. [12]

FREE BULLETIN BOARD: new electronic bulletin board for R/C modeling enthusiasts; 1200/2400 baud support. (315) 652-5641. [12/1]

WANTED: slot cars; '60s or '70s era; HO Aurora, Cox or Monogram; parts also. Dewitt Barham, 8371 Bashan Lake Ave., San Diego, CA 92119; (619) 463-7099. [12]

COLLECTORS' EDITION: "Striking Back"—Last air show at Ida Grove. Show has been sold. Get your copy today. Huge atomic-bomb simulation explosion, fireball explosions, dozens of R/C aircraft; $^1/_5$ scale, including the B-29. Best air show in Midwest; crisp stereo sound, VHS 54 mins., $29.95. WARBIRD "SPECTACULAR"—90 mins.; WW II, several hundred warbirds in Arizona and Wisconsin; many operational; demonstration takeoff flying in Wisconsin, a huge collection in Arizona, some operational. VHS 90 mins. $29.95—Visa/Mastercard/check/M.O. welcome. **HOLIDAY SPECIAL.** Save $10: buy both videos for $49.90 + $3.50 S&H per order, plus $1.50 for each additional tape. Canada, add $5, plus $1.50 for each additional tape. Foreign, add $7.50 per tape; Iowa residents add 5% sales tax. Orders: (515) 277-7218; Chu-Chu Video Productions, P.O. Box 762, Des Moines, IA 50303. [12]

VIDEO: Top Gun '92 —"Flying with The Best." Greatest R/C video ever produced. Multi-camera coverage. Spectacular crash and slow-motion footage. Much more! $29.95 + $3.25 shipping. Call (800) 972-4847. Telstar Video Productions, Inc., 114-3 Semoran Blvd., Winter Pk., FL 32792. [12/1/2]

TALK IS CHEAP!! You call, we send a vinyl graphic and our catalogue, FREE! Silicon Valley R/C Technologies—(800) 822-1500. [12/1/2]

EXPERIMENTAL ROCKETRY: Missiles, motors, launchers. $3. Northstar-A3, 813 Cherry Ave., Albany, GA 31701. [12]

U-CAN STOP SMOKING: Powerful 3-part program: two booklets and cassette tape. Guaranteed results! Send $14.95 to Box 10100, Bradenton, FL 34282. (AMA member.) [12,1,2]

SECRET SOURCE: Ready-to-fly electric-powered glider with radio installed. Unbelievable performance at crazy, low price. I bought three. Source and details $3. Charles Rawnsley, 56 Florida St., Lowell MA 01852. [12,1,2]

SELL: old kits, gas, rubber, solid; engines, glo/ign., used, new, original instruction sheets, accessories, parts; SASE for list. R.E. Jordan, P.O. Box 331045, Ft. Worth, TX 76163. [12]

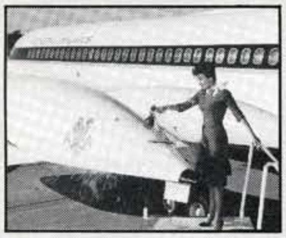
NOVUS, INC. PLASTIC CARE PRODUCTS. Remove minor scratches, paint off-spray, CA, fast, safe, easy. Polish/Cleaner in 2-ounce and 8-ounce kits, $11.95 and $20.95, respectively. Add $3 S&H. Ohio residents add 5.5% S/T. Shipped same day as order received. Hanger Heins Aircraft, 475 Breezy Lane, Cincinnati, OH 45244; (513) 528-7221 for information. [12]

NAME THAT PLANE

CAN YOU IDENTIFY THIS AIRCRAFT?

If so, send your answer to *Model Airplane News*, **Name That Plane Contest** (state issue in which plane appeared), 251 Danbury Rd., Wilton, CT 06897.

Congratulations to Murray Brandenburg of Cedar Park, TX, for correctly identifying September's mystery plane—the Convair 990. It was Raquel (probably an American Airlines flight attendant) who broke the champagne bottle over one of the distinctive "speed capsules" that reduced drag at high, subsonic speeds. According to Convair, this streamlining helped the plane to exceed 600mph.



The new transport was equipped with four, General Electric, aft, fan-jet engines and was expected to cut transcontinental nonstop flight time by 45 minutes. The plane was not, however, a commercial success; only about 25 were ever delivered, and most were taken by American Airlines.

The winner will be drawn four weeks following publication from correct answers received (on a postcard delivered by U.S. Mail), and will receive a free one-year subscription to **Model Airplane News.** If already a subscriber, the winner will receive a free one-year extension of his subscription.

PROGRAMMING

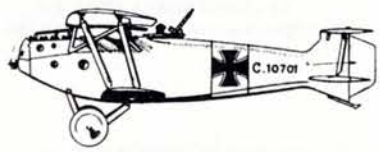
(Continued from page 130)

"Set" flashing in the display. Move the transmitter throttle stick to the halfway position, and depress both Data Input keys simultaneously. Moving the throttle stick should now actuate the spoilers. If it doesn't, return with the cursor key to the channel-1 or channel-6 servo-throw setting. It may be necessary to enter a negative number with the "-" Data Input key so that -40 percent gives the proper "up" spoiler deflection.

Next month, we'll continue our discussion of fun-fly aircraft, and we'll look at programming requirements using other popular radios.

The new breed of fun-fly competitions are won by the pilots who can think, build and fly a fraction better than their peers. The design for the next Nationals winner is just waiting to be born, and in what other facet of our hobby can you build a world beater for $60 worth of materials!

*Here's the address of the company featured in this article:
Futaba Corp. of America, 4 Studebaker, Irvine, CA 92718. ■



ADVERTISER INDEX